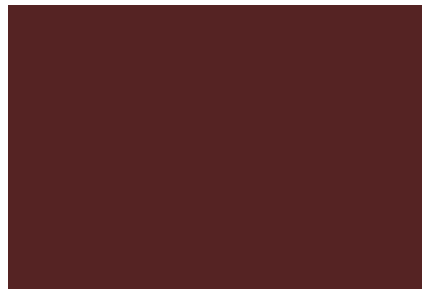


HAZARDS MITIGATION PLAN UPDATE





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COLLEGE OF BUILT ENVIRONMENTS
UNIVERSITY OF WASHINGTON

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Executive Summary

This Hazards Mitigation Plan (HMP) Update focuses on long-term improvement and protection of the built and natural environments, infrastructure, communication networks and the livelihood of the City of Redmond. This plan strives to reduce the financial impacts resulting from hazards and create a community more resilient to inevitable hazards.

Through a hazards assessment process, the project team identified hazards that pose a significant threat to Redmond, those that pose a less significant threat, and those that are emerging threats. Severe storms and earthquakes pose the greatest threat to Redmond. Severe storms are expected to increase in frequency and severity as the Northwest becomes more affected by Climate Change. Earthquakes occur infrequently, but the potential devastation of Benioff, Crustal and Subduction earthquakes make this hazard a significant concern.

This 2009 HMP Update builds on the 2004 HMP, with new attention paid to the impacts of Climate Change. Recent studies, recognized by both the state and federal governments, indicate that the weather in the Northwest will be more severe than historical trends, exacerbating current threats and creating new areas of concern.

The project team took a comprehensive approach to develop mitigation strategies. Through a review of the current state of the community, a public process, working with the Mitigation Implementation Committee, and reviewing existing plans, the team developed a set of strategies to minimize the potential impacts of hazards in Redmond. A detailed list of action items supports the following strategies:

1. *To mitigate impacts involved with isolation following a severe hazard event, Redmond will develop outreach activities to enable Redmond residents, businesses and visitors to survive in-place for more than three days.*
2. *To ensure provision of vital services following a hazard event, Redmond will develop alternative service centers in less hazardous areas.*
3. *To mitigate damage to vulnerable structures and infrastructure, Redmond will promote retrofitting with safe-to-fail mechanisms.*
4. *To mitigate against the loss of major transportation facilities in and around the City, Redmond will invest resources in building more resilient transportation networks.*
5. *To mitigate against the functional loss of business communities, Redmond will develop and deliver business outreach programs.*
6. *To mitigate impacts from expected increases in incidences of shallow flooding, Redmond will build a flood tolerant community able to accommodate increases in low impact flooding.*

How to Use This Plan

The 2000 Stafford Act, also known as the Disaster Mitigation Act (DMA) of 2000 (Public Law 106-390), made Hazards Mitigation Planning mandatory. Prior to 2000, Federal grant programs existed to provide funds for disaster relief, recovery, and to some extent hazards mitigation planning, but municipalities were not obligated to submit mitigation plans. The DMA strengthened federal legislation by emphasizing mitigation actions and promoting pre-disaster planning.

According to FEMA, “mitigation is the effort to reduce loss of life and property by lessening the impact of disasters.”¹ Mitigation includes both structural and non-structural solutions. For example, city codes that prohibit new development in floodplains, community education programs and retrofitting old buildings are all encompassed in mitigation. The City of Redmond Hazards Mitigation Plan (HMP) identifies and outlines strategies to reduce potential impacts of natural hazards. Implementation of the plan will increase public safety and minimize recovery costs.

The HMP is one part of emergency management. Mitigation refers to the actions designed to decrease the impact of an event. The other three elements of emergency management are preparedness, response and recovery. Those phases are addressed in separate, but correlated plans.

This new plan expands upon existing work and information gathered by the City of Redmond’s 2004 HMP and 2006 plan update. The HMP serves as a basis for city-level emergency management planning and programming. It helps local businesses, community services, and school districts develop similar documents and coordinate overall disaster mitigation planning efforts. This document is an important first step toward making the City of Redmond more resilient to natural disasters.

This HMP identifies nine hazards that pose a threat to the City of Redmond. Mitigation efforts are considered for the following hazards:

- Severe Storms
- Earthquakes
- Floods
- Fire
- Landslides
- Pandemics
- Heat Waves
- Drought
- Hazardous Materials

This HMP defines each hazard, assesses the risk to the City of Redmond, and provides long-term mitigation strategies. The primary users of the document will be the City of Redmond Planning Department, Emergency Management, and Emergency Services.

¹ FEMA, “FEMA: Mitigation,” <http://www.fema.gov/government/mitigation.shtm#1>.

The document contains information relevant to other departments, including Public Works, the Parks Department, Information Systems GIS Division, and Financial Services. The HMP will be publically available.

Plan Organization

This HMP is organized into five parts and 14 chapters that follow the phases of the plan's development as follows:

Part 1 - Introduction and Community Profile

Part 2 - The Planning Process

Part 3 - Hazard Identification and Risk Assessment

Part 4 - Mitigation Strategies

Part 5 - Plan Maintenance

Supporting documentation, maps, tables, and public participation instruments are included throughout the document and/or in the appendices.

The following matrix summarizes where and how this plan has been updated from the 2006 and 2004 versions of the Redmond Hazard Mitigation Plan.

Parts	2004	2006 Review	Revision to Updated Plan	
			2009 - Update	Reasons for Change
Part 1 - Introduction and Community Profile	Community profile Information reflected information available in 2004.	Community profile relied on information available in 2004 Plan	Introduction was changed to reflect 2009 Plan. Community profile was updated where more current data was available. New Census Tract and block census data was not available. New data from US Bureau of the Census principally the "2005-2007 American Community Survey, Housing Characteristics" was used where appropriate. Revised City planning areas and vision statements were incorporated into process.	Changes were made to make HMP current and describe analysis.
Part 2 - Planning Process	The 2004 HMP was the product of a process that included a number of contributors in the City of Redmond. This body of contributors evolved into the Mitigation Implementation Committee (MIC)	Review process relied on assessing Action items by Mitigation Implementation Committee (MIC)	Update relied on the Mitigation Implementation Committee (MIC) and public participation. The MIC process afforded Project Team access to professionals in Redmond. The public participation included public meetings, workshops, surveys, and public reviews.	Update includes use of Web site and online surveys not available in 2004. Document was redesigned to be more readable. Changes reflect new data and a maturing by the City gaining capabilities. Completed Action Items described and new items included with six mitigation strategies.
Part 3 - Hazard Identification and Risk Assessment	In support of the risk analysis and to provide a visual image of risk, three scenarios were included: Large-Scale Regional Event (Seattle Fault), Small-Scale Localized Event (landslide) and Catastrophic Localized Event (Pipeline explosion). The Hazard Identification and Vulnerability Analysis (HIVA) used data available in 2004. Hazards Included: <ul style="list-style-type: none"> • Drought • Earthquakes • Epidemics • Flooding • Hazardous Materials • Heat Waves • Landslides • Terrorism • Wildfire • Winter Storms 	Scenario events driving review remained unchanged. Review considered the following hazards and vulnerabilities in addition to those included within the original Plan. <ul style="list-style-type: none"> • Climate changes • Seattle Fault • Pandemic • Terrorism • The "Katrina Effect" -- Isolation 	The 2009 Update applied a new risk algorithm to hazards included in the 2004 Plan as amended in 2006. Similar to the 2004 Plan, risks were driven by three probable scenarios looking at regional, municipality-wide and localized events. These included Crustal Earthquake, Winter Storm and Landslide. Following are specific changes by hazard. <ul style="list-style-type: none"> • Climate change: Not included in 2004. Analysis relied on data provided by UW Climate Impact Group (CIG) and International Panel on Climate Change (IPCC). Probable impacts were included in analysis of secondary hazards: heat waves, flooding, wildfire, landslides and drought. • Winter Storms: Analysis updated with current information and knowledge gained from recent storms. • Earthquakes: Added emphasis was given to impacts from a South Whidbey Fault event. New soils data and results of Seattle Fault HAZUS runs incorporated into analysis. • Flood: New flood event information, insurance policy, topography and land use information incorporated. • Wildfire: New land used data factored into analysis. • Landslides: Revised inventories and land use data were incorporated into analysis. • Pandemics: H1N1 impacts along with changes in land use were included. • Heat waves: Analysis was updated with recent information • Drought: New information built upon 2004 analysis • Hazardous Material: New SARA Tier II and LEPC data was incorporated into analysis. 	Update took advantage of new data leading to new perceptions of risk.
Part 4 - Mitigation Strategies	Plan product of 2004 process that resulted in 10 Action items.	An assessment of 2004 items and a revised list of action items were offered.	Six strategies are offered with actions items included within each strategy. New and updated Action Items and mitigation strategies were prioritized, based on new 2009 risk and benefit cost analysis, importance to the life and safety of the Redmond.	The Planning Team and MIC felt that including Action Items within Strategies make the items easier to understand and implement.
Part 5 - Plan Maintenance	Established membership and offered procedures for MIC.	Review process relied on Mitigation Implementation Committee	The Redmond Office of Emergency Management remains responsible for plan maintenance. Role of MIC remains unchanged.	Basic process remains unchanged. Emphasis given to public process expanded and designed to exploit new technologies.

1.1 Introduction

This plan is an update of the 2004 City of Redmond Hazard Mitigation Plan (HMP). Although it is an update, this document has been redesigned so that it looks, feels, and reads differently than the original. This is due to several factors: new hazard information has become available that drives new definitions of risk, the City has matured and new capabilities are now available, and the new format will allow readers to more easily understand the content. In addition, the 2004 HMP included several action items that have been completed, creating an opportunity for developing new mitigation strategies. There were several aspects of the 2004 plan that were found to be deficient or insufficient to be included in the 2009 update. As a result, those items have been revised or removed and replaced with new items or strategies that better reflect the current conditions and environment in Redmond.

There is a variety of hazards that pose risks to people and property in Redmond. A hazards event becomes a disaster if vulnerabilities are high and capabilities insufficient. The extent of destruction resulting from an event is determined by the degree to which vulnerabilities cannot be protected. Redmond is at risk of both natural hazards, such as earthquakes, and human caused events, such as a hazardous material spill. In both cases, damages can be exacerbated by alterations to the natural environment.

This HMP focuses on long-term improvement and protection of the built and natural environments, infrastructure, communication and the livelihood of the community. This plan strives to reduce the financial impacts and make the community more resilient to inevitable hazards.

This HMP identifies the hazards that pose the greatest risk to the City of Redmond. The risk assessment section examines the four factors of risk: location, timing and duration, severity, and frequency. The results of this risk assessment serve as a basis to determine which hazards demand the most attention in this plan. Hazard specific vulnerabilities are addressed in Part 3, Risk Assessments.

This plan includes several hazards-related scenarios to help readers conceptualize a hazards event. The scenarios include probable secondary hazards. Through critical analyses and public input, this plan concludes with a set of long-term strategies and action items that call for more immediate attention.

1.2 Objectives, Strategies and Action items: 2004, 2006, 2009

Based on the goals of Redmond's Comprehensive Plan, the Project Team designed the following objectives, strategies and action items for Redmond's 2009 Hazards Mitigation Plan. This plan recognizes that hazardous events are unavoidable. Given the distribution of vulnerabilities across the City and the potential magnitude of

hazardous events, parts of Redmond may experience isolation. Therefore, the strategies outlined in this section are intended to both increase the self-sufficiency of Redmond residents and to increase the City's resiliency to minimize the duration of that isolation. The strategies revolve around the following concepts:

- Survival education for isolated individuals
- Robust emergency services
- Neighborhood isolation from utilities and infrastructure
- Retrofit of utilities
- Retrofit of historic building stock
- Reinforcement of transportation facilities and diversity modal alternatives

For a complete list of 2009 objectives, strategies, and action items related to strategies above, please refer to Part 4, Chapter 13, Mitigation Strategy.

Tables 1 and 2 list action items from 2004-2006 and the current status. The progression of topics, specificity and tone from 2004 to present indicates shifting levels of concerns residents place on potential hazards. Issues that are framing the 2009 update include:

- Disabled transportation networks during the 2008 winter storms
- A one-week power outage in mid-December of 2006 that resulted from the "Hanukkah Eve Wind Storm"
- Hurricane Katrina of 2005 and resulting reforms to FEMA guidelines

2006 Action Items and Current Status		
Rank	Top 10 action items	Current status
1	Identify alternative emergency government operations capability outside of high-risk areas	Ongoing: Very few permanent facilities set up.
2	Partner with King County, neighboring jurisdictions, and WSDOT to harden transportation routes	Complete: Routes hardened within Redmond. City staff is on three regional committees.
3	Strengthen relationships between corporations and vendors, including provisions for Emergency Operations Centers and mutual aid.	Ongoing
4	Reduce risk to the Olympic Pipeline and surrounding areas	Complete: No other politically acceptable options at this time.
5	Implement neighborhood-targeted risk reduction programs	Ongoing
6	Design events promoting business continuity	Ongoing
7	Adopt a Post-Disaster Recovery Plan for Old Town	No change. See #8 for further details.
8	Retrofit historic downtown structures	Ongoing
9	Support regional mitigation initiatives	Completed
10	Enhance existing GIS capabilities emphasizing hazard analysis	No change

Table 1: 2006 Action Items and Current Status

Table 2 presents a review of the update of 2004 Action Items list, as included in the 2006 Hazards Mitigation Plan Update.

2004 Action Items and Current Status			
Rank	Activity	Description of Activity	Status
1	Development of Wellhead Protection Ordinance	Study of Redmond aquifers and sensitive areas. Development of regulations for protection of city wells and aquifers.	Complete
2	Wellhead 4 Redevelopment	Move Wellhead #4 200 feet east and re-drill. Project designed to guarantee water in the future.	Complete
3	Redevelopment of Wellheads 1, 2, & 3	Retrofitting of wells designed to guarantee water in the future.	Complete
4	Community Awareness Activities	Public education, presentations, support of Community Organizations Active in Disaster, Citizen Corps, and AmeriCorps. Support of countywide regional mitigation efforts.	Ongoing
5	Olympic Pipeline Setback Plan	Participation in development of plans and guidelines for the plan and City ordinance and Development Guide.	Complete
6	Earthquake Strapping	Tie-down of computer and communications equipment (Non-structural mitigation)	Pilot Program In Place
7	Generator Retrofit for the Public Safety Building	Increase emergency capacity from 50% to 100% in the Public Safety Building and Emergency Operations Center. Rerouted exhaust system for safety purposes.	Complete
8	Alternate EOC and Command Post capabilities	Purchased a Mobile Command Unit and installed communication equipment. Set up power and communication connections at strategic locations for alternate emergency operations centers.	Complete
9	Upgraded GIS Capabilities and Distributed Database	Hours assigned to Emergency Management and Hazards Mitigation, Risk Mapping from Management Information Services Division. GIS and distributed database capabilities added to the Emergency Operations Center as a virtual network.	Ongoing
10	Development of Central Receiving	Reduction of terrorism risk through the central processing of mail and packages in a secure location.	Awaiting Funding

1.3 Strengths, Weaknesses, Opportunities and Threats (SWOT)

A SWOT analysis was undertaken to clarify the physical, regional, political and economic factors that influence Redmond's vulnerabilities and capabilities.

1.3.1 Strengths

Redmond is well positioned in regional politics with staff members on three different regional councils. Redmond was largely developed after the 1963 construction of the Evergreen Point floating bridge; consequently, the majority of the buildings were erected within the past 50 years. Despite the recent economic downturn, the local economy remains strong.

Although the valley and hill terrain in Redmond creates areas that are vulnerable to each of the probable hazards, the variation in landscape increases the possibility that damage will be localized. In the event of any hazard, some of the neighborhoods will be less affected than others.

1.3.2 Weaknesses

The Downtown neighborhood and most of Redmond's emergency services are located within the valley, where the liquefaction and flood zones overlap. The Old Town area (with the highest concentration on unreinforced masonry buildings) is also located on these liquefiable, flood prone soils. Despite these factors, Redmond is currently focusing economic redevelopment and increasing residential density in this area. Furthermore, the valley separates the several neighborhoods located on the hills. Although the hill neighborhoods may be unaffected by flooding or an earthquake, isolation may result from network disruptions in the lowlands.

1.3.3 Opportunities

The next earthquake will likely destroy some of the older, non-historic buildings that were constructed prior to the adoption of the International Building Code. This will create an opportunity for new businesses to develop the area with lower demolition costs, leading to the urban revitalization of Redmond's Old Downtown.

Recent winter storms highlight the fact that hazards events cause isolation. This understanding can be used as a catalyst to increase development of pedestrian pathways, open green space, and mixed-use neighborhoods. Pedestrian pathways and diversified land use can provide alternative emergency transportation routes and create staging areas for emergency service provision.

1.3.4 Threats

Economic disruption in the event of a hazard is a major concern for the City of Redmond. Small businesses and vendors in Redmond support larger businesses, like Microsoft and Nintendo USA. Small businesses are particularly sensitive to unexpected losses of income. If a small business is forced to close for a few days, it may not be able to reopen. Redmond needs to take additional precautions to support this sector of the economy to avoid a ripple effect: echoing up from smaller businesses to the larger corporations in the area.

1.4 Local Capabilities Assessment and Integration

A capability is defined as a resource or capacity (human, physical, technical, informational, and/or financial) at all levels of government available for mitigation initiatives and efforts. Not only does the City of Redmond have a robust source of

internal capabilities, it also has many external capabilities offered through regional planning and coordination.

In **Table 3, Capabilities Inventory**, the following definitions are used:

- *Human capabilities*: people assigned to a department for the purpose of emergency management
- *Physical capabilities*: objects, like seismic ties to reinforce a building from an earthquake, available for emergency management
- *Technical capabilities*: software, hardware, equipment, or tools available for emergency management
- *Financial capabilities*: indicates that the department has or is in the process of acquiring financial resources


To ensure integration of available capabilities they are categorized into the four stages of emergency management: mitigation, preparedness, response and recovery. This classification provides a system to analyze capabilities on multiple levels: jurisdiction, organization and department, capability type, and stage of emergency management. Using this organizational structure, priority capabilities were extracted and a gap analysis was used to identify strengths and weaknesses of Redmond's collection of capabilities.

Based on the inventory of Redmond's capabilities, the top five capabilities of the City include:

- Local Hazardous Waste Management Program
- Redmond Critical Areas Ordinance 2005
- Redmond Downtown Transportation Master Plan
- Washington State Emergency Management Pre-Disaster Mitigation Grant Program
- Emergency Operating Services Agreement with King County Fire Protection District 34.

Table 3, Capabilities Inventory, is a reference matrix of government agency capabilities.

		Human	Physical	Technical	Information	Financial
City	Finance & Information Services					
	Fire Department					
	Human Resources					
	Parks and Recreation					
	Planning and Community Development					
	Police					
	Public Works					
	Communications					
	City Council					
	Department of Transportation					
	Emergency Management					
Regional	Eastside Public Safety Communications Agency					
County	Department of Transportation					
	Office of Emergency Management					
	Sheriff's Office					
	Fire Marshal Division					
	Evergreen Healthcare Hospital District					
	County Library System					
	Solid Waste Division					
	Seattle-King County Department of Public Health					
	King County Library System					
	Regional Public Information Network (RPIN)					
State	Department of Transportation					
	Emergency Management Division					
	State Patrol					
	Military Department					
	Urban Search and Rescue					
	State Building Code Council					
	National Guard					
Federal	Small Business Administration					
	FEMA					



- Preparedness
- Response
- Recovery
- Mitigation

Table 3: Capabilities Inventory

1.5 Related Documents

The following is an abbreviated list of documents most relevant to the 2009 City of Redmond Hazards Mitigation Plan. Specific references are included as footnotes throughout the HMP.

Redmond Comprehensive Plan

<http://www.redmond.gov/intheworks/redmond2022/planupdates.asp>

<http://www.redmond.gov/insidcityhall/documentlibrary.asp#Land>

2009 Comprehensive Flood Hazard Management Plan

<http://redmond.gov/insidcityhall/publicworks/stormwater/floodplan/default.asp>

Redmond 2006 Hazard Mitigation Plan

<http://www.redmond.gov/insidcityhall/planning/mitigation/mitigation.asp>

Redmond Critical Area Ordinance

<http://www.redmond.gov/intheworks/criticalareas/>

Redmond Recovery Plan

Contained in this plan as an Annex, see page 199

Redmond Comprehensive Emergency Management Plan

Currently being updated.

King County Hazard Mitigation plan

<http://www.kingcounty.gov/safety/prepare/EmergencyManagementProfessionals/PlansandPrograms/RegionalHazardMitigationPlan.aspx>

State of Washington Military Department, Emergency Management Division: Hazard mitigation Plan

http://www.emd.wa.gov/plans/washington_state_hazard_mitigation_plan.shtml

State of Washington Department of Ecology Shoreline Management Act

<http://www.ecy.wa.gov/programs/sea/SMA/index.html>

FEMA

<http://www.fema.gov/about/divisions/mitigation.shtm>

<http://www.fema.gov/plan/mitplanning/index.shtm>

1.6 City Council Adoption Resolution

FEMA requires that the HMP be adopted by City Council. Below is a draft resolution, the approved resolution should be inserted into the Final copy of the HMP.

RESOLUTION NO. _____

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF REDMOND ADOPTING THE CITY OF REDMOND HAZARD MITIGATION PLAN (HMP) UPDATE FOR 2009-2014 AS APPROVED BY THE FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)

WHEREAS, Section 322 of the Federal Disaster Mitigation Act of 2000 requires local government agencies to develop and submit an All-Hazards Mitigation Plan in order to receive future Hazard Mitigation Grant Program Funds; and

WHEREAS, the City has knowledge and experience that the natural and man-made hazard events pose threats to lives and cause damages to property within the City of Redmond; and

WHEREAS, staff working with technical experts and the University of Washington have used available technologies, information, and historical documents to conduct a comprehensive risk reduction analysis process resulting in the preparation of the City of Redmond HMP Update; and

WHEREAS, the HMP Update formalizes the City's comprehensive efforts to make the City safer through preventing damage in the built environment; and

WHEREAS, the HMP builds on the objectives and actions established in the 2004 HMP and the City of Redmond's Comprehensive Plan; and

WHEREAS, the HMP has been reviewed by all relevant departments, boards, committees, and the Governor's Office of Emergency Services; and

WHEREAS, the HMP update was presented to Council and was available for public comment and review for the required time period; and

WHEREAS, approval of the HMP Update by FEMA constitutes formal completion of the plan and establishes eligibility for the City to pursue Hazard Mitigation funds.

NOW, THEREFORE, BE IT RESOLVED that the Redmond City Council does hereby adopt the City of Redmond Hazards Mitigation Plan in accordance with the Federal Disaster Mitigation Act of 2000 thereby meeting the eligibility requirements for the potential receipt of Hazard Mitigation Grant Funds.

1.7 FEMA Approval Letter

The FEMA Approval Letter will be inserted into this HMP once it is received.

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2.1 Community Profile

This plan is an update of the 2004 City of Redmond Hazard Mitigation Plan (HMP). Although it is an update, this document has been redesigned so that it looks, feels, and reads differently than the original. This is due to several factors: new hazard information has become available that drives new definitions of risk, the City has matured and new capabilities are now available, and the new format will allow readers to more easily understand the content. In addition, the 2004 HMP included several action items that have been completed, creating an opportunity for developing new mitigation strategies.

2.1.1 Location, Geography and Neighborhoods

The City of Redmond is located on the east side of Lake Washington. It is part of King County and within the greater Puget Sound region (see **Map 1, Regional Location Map**). The Sammamish River and Bear Creek pass through the City. The Cascade Range, a 1,000-mile long chain of volcanic mountains, which extends from northern California to southern British Columbia, is located to the east of Redmond.

The City topography includes hills and valleys. The soil in the valley is classified as alluvial soils, which will liquefy during an earthquake. Some of the hills surrounding the valley have steep slopes. Two large park facilities are adjacent to Redmond, Willows Run Golf Course to the north and Marymoor Park to the south (adjacent to Lake Sammamish).

There are ten neighborhoods in Redmond:

North Redmond borders the Sammamish Valley and is north of the Education Hill neighborhood. This neighborhood is located on one of the City's three hills (Education Hill). The area is residential, primarily single family housing. There are a few parcels in the neighborhood that are zoned commercial. This area could be isolated from services if transportation routes are limited due to a hazards event. Fire Station 17 is scheduled to begin construction in 2010-2011.

Education Hill is located in northeast Redmond. Education Hill is primarily low- to moderate-density residential. There are very few services that are currently available in the neighborhood and they are likely to become isolated in the event of a hazard. There are numerous schools and open space that could be utilized for emergency response and recovery.

Sammamish Valley is located in the valley floodplain. The area is characterized by large amounts of open space, parks and dense residential housing. This neighborhood is located both in the floodplain and the liquefaction zone.

Willows and Rose Hill is located in northwest Redmond. This is a hill neighborhood

that is primarily residential. The Olympic Pipeline runs through this neighborhood.

Overlake neighborhood is the second commercial center, after Downtown, in Redmond. It is located on a hill in the southwest region of Redmond. This area has residential, commercial and business parks. Microsoft is located in Overlake neighborhood. This location may provide opportunities for emergency operations, but it is located very close to the Seattle Fault and would experience extreme ground shaking in the case of an earthquake along the Seattle Fault.

Grass Lawn is located north of Overlake on the western side of Redmond. This hill neighborhood is mostly low- to moderate-density residential.

Viewpoint is Redmond's lakefront neighborhood. It is located along the Sammamish Lake, east of Overlake. The neighborhood is primarily low- to moderate- density residential. Along the lake there are some multi-family buildings. Home values are especially high in Viewpoint. There are several schools, churches and open space.

Bear Creek is located in the central eastern river valley in Redmond. This is the least populated of Redmond's neighborhoods and has the most diversity in zoning. There are residential areas to the north and west sides of the neighborhood. The residential area includes a mobile home park and the largest retirement community in the City. There is some community retail in the north. The central area has resource lands. South of Bear and Evans creeks provides commercial and industrial land.

Downtown is located in central Redmond on the valley floor, which is subject to both floods and liquefaction. City services are located in the downtown area, including City Hall, the primary Fire Station, Police Station and most of the commercial retail. Dense transit-oriented development has been encouraged in this area. This area has dense residential housing.

Southeast Redmond is partially located on the hill and partially in the valley. This neighborhood has residential, commercial and manufacturing parks.

Map 2, Overview of City of Redmond Neighborhoods, shows the location of the neighborhoods.

2.1.2 Demographics

According to the US Census, the City of Redmond is home to 51,530 residents. The City of Redmond currently covers over 16.6 square miles. Since 2000, the population has increased from 45,649 to 51,530 (see **Map 3, Population Density by Census Block**).

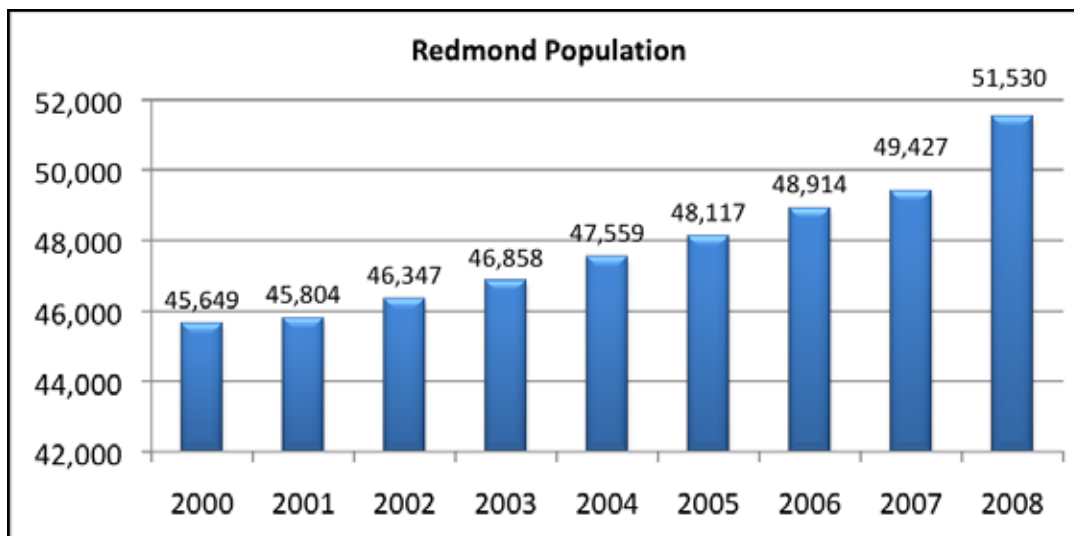


Figure 1: The City of Redmond Population Growth, 2000-2008.²

The majority of residents are between the ages of 18 and 64. The percentage of residents within this age group has increased since 1970 (see **Figure 2, Residents Age Group**, change by decade). According to data from 2007, just over 20% of the City of Redmond's population is under 18, approximately 70% of residents are between 18 and 64, and just under 10% are 65 and older.

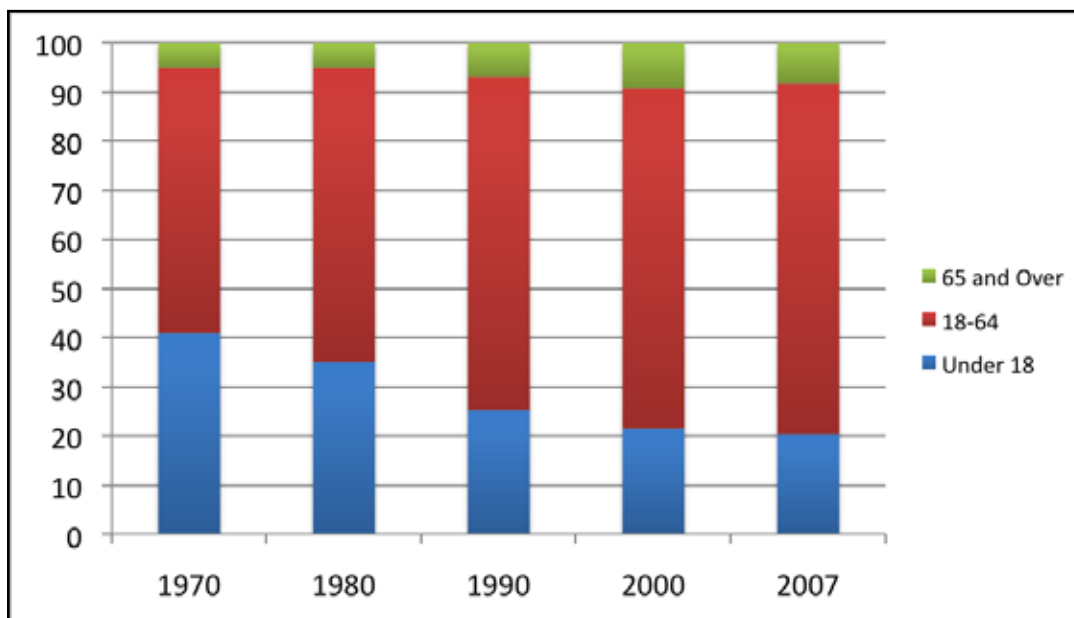


Figure 2: The City of Redmond Residents Age Group, change by decade, 1970-2007.³

² Data from US Bureau of the Census Factfinder, http://factfinder.census.gov/servlet/GCTTable?_ds_name=PEP_2007_EST&-mt_name=PEP_2007_EST_GCTT1R_ST9S&-geo_id=04000US53&-format=ST-9&-

³ Data from US Bureau of the Census, 1970 to 2000, "2005-2007 American Community Survey Profile Highlights," http://factfinder.census.gov/servlet/ACSSAFFacts?_event=Search&geo_id=01000US&-geoContext=01000US&-street=&-county=redmond&-cityTown=redmond&-state=04000US53&-zip=&-lang=en&-sse=on&ActiveGeoDiv=geoSelect&-useEV=&pctxt=fph&pgsl=010&-submenuId=factsheet_1&-ds_name=ACS_2007_3YR_SAFF&-ci_nbr=null&-qr_name=null&-reg=null&-keyword=&-industry=

The City of Redmond is comprised of mainly residential and business structures. Of the residential structures, the majority are detached single units (39%) (see **Map 4, City of Redmond Commercial and Residential Buildings**). Second most common are structures that accommodate ten to nineteen units (15%) with three- to four-unit structures the third most common type (14%) (see **Figure 5, Number of Housing Units**).

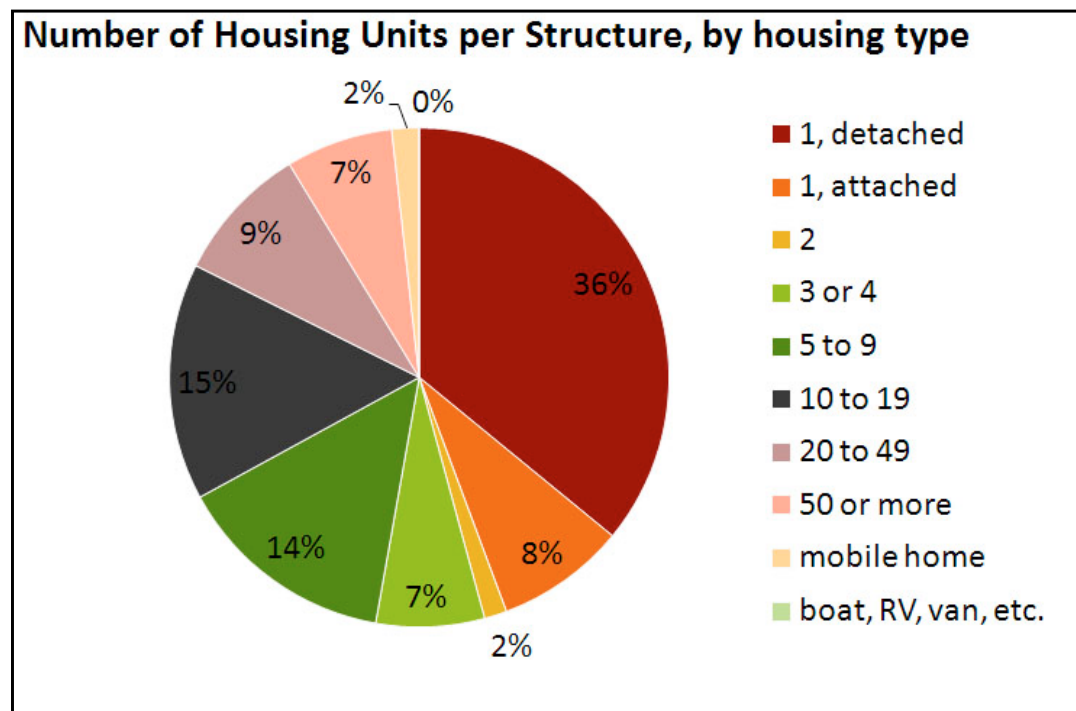


Figure 5: Proportion of housing unit types classified by number of housing units per structure.⁶

2.1.3 Household Income and Education

According to the City of Redmond income data from 2005 - 2007, the median income of households in the City of Redmond was \$82,349. About 89% of the households received earnings, and the average income from earnings was \$90,677; other income sources include Social Security income (13.9%) and retirement income (9.8%). These income sources are not mutually exclusive; some households received income from more than one source.⁷

The City of Redmond is part of the Lake Washington School District, which also includes Kirkland and parts of Sammamish and Woodinville. The public schools in the City of Redmond include several elementary schools, junior high schools, and Redmond High School. Three private schools offer secondary education: the Overlake School (secular), the Bear Creek School (Christian - primary and secondary), and the Conservatory High School (for performing arts students). Ninety-five percent of Redmond's adult population holds a high school diploma or higher, which is

6 Data from US Bureau of the Census, "2005-2007 American Community Survey, Housing Characteristics," http://factfinder.census.gov/servlet/ADPTable?_bm=y&-geo_id=16000US5357535&-qr_name=ACS_2007_3YR_G00_DP3YR4&-context=adp&-ds_name=&-tree_id=3307&-_lang=en&-redoLog=false&-format=.

7 Ibid.

significantly higher than the Washington State average.

2.1.4 Workforce

In the City of Redmond's economic survey 2005 - 2007, there were 32,187 people in the labor force, 72.3% of the population 16 years and over.⁸ Moreover, the unemployment rate in Redmond was 3.5%. In the City of Redmond's occupational distribution "management, professional and related occupations" and "sales and office occupations" are primary occupations in Redmond. The former accounts for 60.7% and the latter for 20.2% of total occupations. Approximately 9.3% of employees in Redmond are in the service sector.

Table 4, Redmond's Main Industries of 2002, provides a list of the key industries in Redmond. The information industry is very important to Redmond, as exhibited by the high number of paid employees in this sector. Manufacturing and wholesale trade are also important industries.

NAICS	Description	Establishments	Sales, receipts or shipments (\$1,000)	Annual payroll (\$1,000)	Paid employees
31-33	Manufacturing	177	2,264,588	416,018	8,394
42	Wholesale trade	267	5,091,283	267,102	4,719
44-45	Retail trade	255	673,872	92,396	3,442
51	Information	79	N ¹	D ²	(25k-49k)
54	Professional, scientific, & technical services	318	443,045	202,625	3,545
56	Administrative & support & waste management & remediation service	101	236,924	148,523	3,315
62	Health care & social assistance	186	287,820	98,756	3,443
72	Accommodation & food services	196	160,857	51,683	3,532

Table 4: Redmond's Main Industries in 2002

Source: U.S. Census Bureau, "Redmond City's Summary Statistics by 2002 NAICS," <http://www.census.gov/econ/census02/data/wa/57535.HTM>.

1. Not available 2. Withheld to avoid disclosing data of individual companies; data are included in higher level totals

2.1.5 Economic Trends

The City of Redmond is well known as a center of technology and the location for a number of nationally known high tech and biomedical companies. Among these are Microsoft, Nintendo, AT&T and Physio-Control.⁹ In addition, Redmond Town Center is a large downtown retail center, which offers numerous shops, restaurants, movie theaters, special events, and live performances by a repertory theatre company and other arts-related groups.

⁸ U.S. Census Bureau, "2005-2007 American Community Survey-Redmond Economic Characteristics," http://factfinder.census.gov/servlet/ADPTable?_bm=y&-geo_id=16000US5357535&-qr_name=ACS_2007_3YR_G00_DP3YR3&-ds_name=ACS_2007_3YR_G00_&-lang=en&-sse=on.

⁹ The City of Redmond, "Redmond's General Information," <http://www.redmond.gov/aboutredmond/general.asp> (Accessed on February 20, 2009).

According to the City of Redmond's Comprehensive Plan, in 1993 employment within the City was 39,000; by 2004 employment had doubled to 79,500.¹⁰ This significant growth in jobs places Redmond as the fourth largest employment center within the four-county central Puget Sound area. While much of this growth has been in software and businesses services, there has also been significant growth in communications and retail. Despite a decline in traditional manufacturing, the City of Redmond has experienced a net job increase almost every year since 1993.

In terms of future projections, the Puget Sound Regional Council has forecasted that jobs could increase within Redmond to 100,000 in 2020 and 111,000 by 2030. The City of Redmond plans to accommodate up to a total of 106,000 jobs by the year 2022, which is consistent with the region's 20-year employment target.¹¹

2.1.6 Transportation

The City of Redmond is connected to the greater Puget Sound region by two major state highways, Highway 202 and Highway 520. Highway 202 runs mainly north and south from south east of Redmond into the center of the City and up through the north. Highway 520 runs adjacent to the south side of the City of Redmond and connects with both Redmond Way and Avondale Road NE. Other major arterials in Redmond include: 166th Avenue NE, 154th Avenue NE, 148th Avenue NE, NE 116th Street, NE 128th Street, NE 124th Street, NE 104th Street, NE 90th Street, NE 85th Street, Cleveland Street, Redmond Woodinville Road, and West Lake Sammamish Parkway NE (see **Map 5, City of Redmond Motorized Transportation Network**).

The City has made major investments in the pedestrian network. In March 2009, the City of Redmond received a \$170,000 grant from the Highway Safety Improvement Program to improve crosswalks within Redmond.¹² Sidewalk additions are also slated for the south side of NE 90th Street between Willows Road and 154th Avenue NE. The City of Redmond has an extensive and well connected sidewalk system.

The bicycle network in the City of Redmond supports bicycle commuting with over 80 miles of bicycle lanes. The City provides bike-specific paved pathways, unpaved pathways/trails, shared pedestrian and bike pathways, bike lanes on roads with extra wide shoulders, and 'sharrow' traffic streets with identified traffic levels (e.g. medium and high).¹³ To accommodate recreational riding, the commuter routes have connections with the Sammamish River trail, which runs to the north of Redmond (see **Map 6, City of Redmond Non-Motorized Transportation Network**).

¹⁰ City of Redmond, "City of Redmond Comprehensive Plan," <http://www.codepublishing.com/WA/Redmond/CompPlan/HTML/redmondcomp07.html>.

¹¹ Ibid.

¹² The City of Redmond, "Press Release: Construction at Redmond Way and Cleveland Street", <http://www.redmond.gov/aboutredmond/pressreleases/pr0918.asp>.

¹³ The City of Redmond Bicycling Guide, "Bike Map," <http://www.redmond.gov/cityservices/maps/bikemap.pdf>.

2.1.7 Critical Facilities

A variety of critical facilities are found in the City of Redmond. Within the context of the Hazards Mitigation Plan, critical facilities are defined as a building or infrastructure that is central in supporting the provision of services to and by the City of Redmond. FEMA provides a definition of critical facilities by listing examples including hospitals, fire stations, police stations, storage of critical records, and similar facilities.¹⁴ Redmond is currently scheduled to repair and/or replace vulnerable portions of its sewer and water lines in the next three years, providing an opportunity for seismic and anti-flooding upgrades. In recent years seismic upgrades have been done to the most vulnerable water tanks within the City limits. Although there are still a few water tanks that are not seismically reinforced, there is no current plan to upgrade them.

Other types of non-public critical facilities are comprised of the many high-tech industry headquarters in the City of Redmond. Private companies such as Microsoft, Nintendo of America, Honeywell, General Dynamics Airborne Electronic Systems, and Medtronic Emergency Response Systems can be classified as critical facilities to the City of Redmond because of their size and influence on the local and regional economy. The City of Redmond reached out to the Chamber of Commerce to create an education plan for all business owners with regard to emergency preparedness. In addition, neighborhood services such as schools, churches, childcare facilities, the library, and community centers are considered critical facilities. Lastly, systems that provide services to residents and businesses in the City of Redmond are another set of critical facilities. This last set includes links and facilities in the transportation network that connect the City of Redmond to neighboring cities (e.g. SR-520, Redmond Way, and 164th Avenue NE) (see **Map 7, City of Redmond Community Facilities**).

2.2 Community Vision

The following “Goals, Vision, and Framework Policy Elements” section through the “Vision Statement” section paraphrases the Redmond Comprehensive Plan and cross references the previous HMP (2004). The 2004 Redmond HMP quotes these sections directly from the 2004 contemporary Comprehensive Plan with one modification, adding the contemporary council members names. For the complete version of the following “Goals, Vision, and Framework Policy Elements” section, please see the current Redmond Comprehensive plan.¹⁵

2.2.1 Goals, Vision and Framework Policy Element

Redmond’s Comprehensive Plan is a reflection of the long-term values and visions residents have for Redmond over the next 20 years. This section outlines the goals,

¹⁴ FEMA, “FEMA: Critical Facility,” http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/critical_facility.shtm#0.

¹⁵ The City of Redmond, “Comprehensive Plan,” <http://www.redmond.gov/intheworks/redmond2022/planupdates.asp>.

visions, and policies included in that plan.

The goals and framework policies are not listed in priority order, and need to be viewed as a whole, balanced over time. One goal or value shall not be pursued to the exclusion of the others.

2.2.2 Goals for Redmond

- To conserve agricultural lands and rural areas, and to protect and enhance the quality of the natural environment.
- To retain and enhance Redmond's distinctive character and high quality of life, including an abundance of parks, open space, good schools and recreational facilities.
- To emphasize choices in housing, transportation, stores and services.
- To support vibrant concentrations of retail, office, service, residential, and recreational activity in Downtown and Overlake.
- To maintain a strong and diverse economy, and to provide a business climate that retains and attracts locally owned companies as well as internationally recognized corporations.
- To promote a variety of community gathering places and diverse cultural opportunities.
- To provide convenient, safe and environmentally friendly transportation connections within Redmond, and between Redmond and other communities for people and goods.
- To remain a community of good neighbors, working together and with others in the region to implement a common vision for Redmond's future.

2.2.3 Our Future Vision for Redmond in 2022

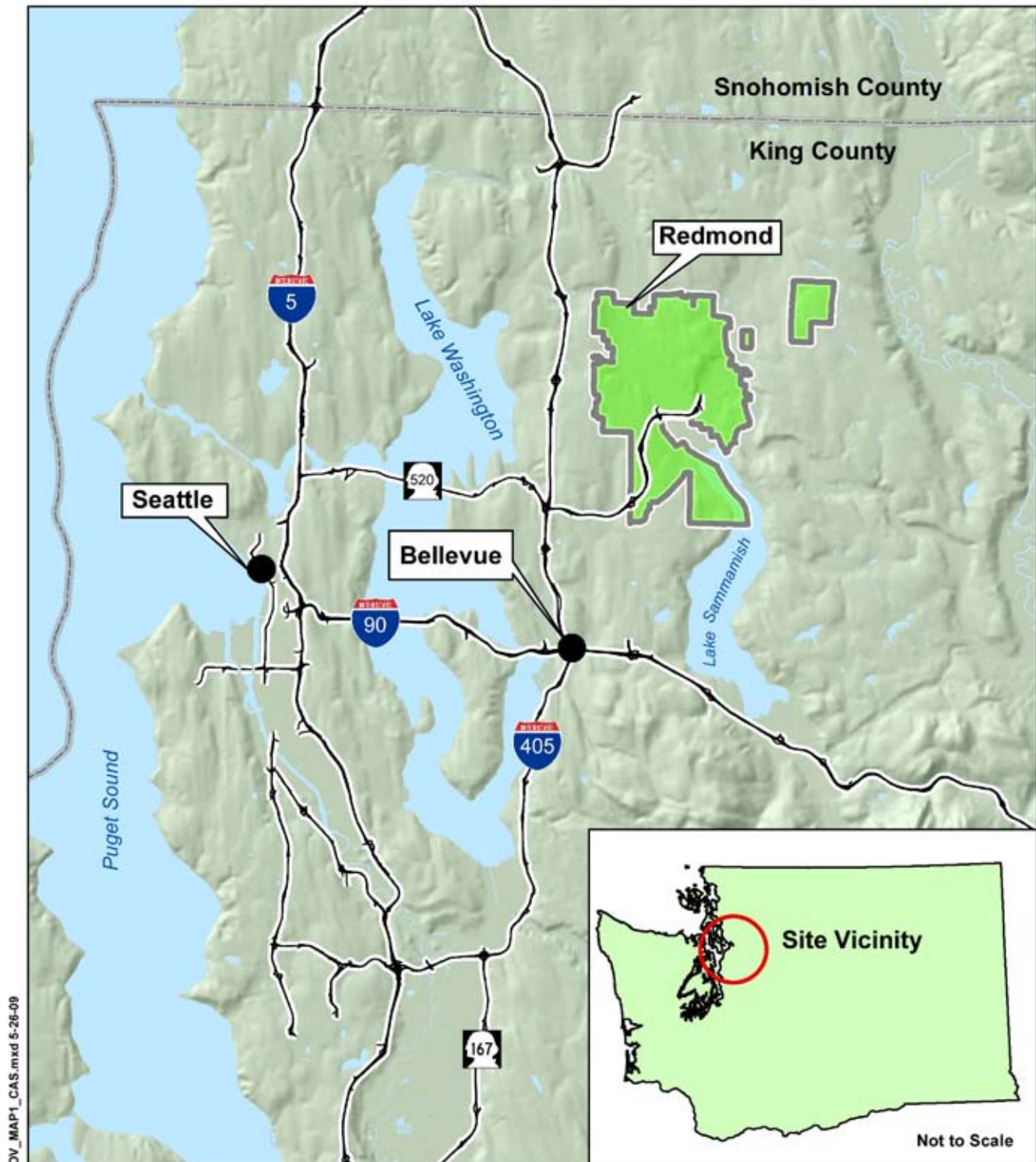
What would Redmond be like as a place to live, work, or visit if the community's values were achieved? The vision statement describes Redmond in the year 2022 if the Comprehensive Plan were implemented.

2.2.4 Vision Statement

- Downtown is an outstanding place to work, shop, live and recreate.
- Old Town thrives as a focus for retail activity that attracts pedestrians.
- Overlake has become recognized as a regional urban center.
- Residential neighborhoods are treasured for their attractiveness, friendliness, diversity, safety, and quietness.
- A strong economy and a diverse job base.
- Neighborhood and community parks contribute to a high quality of life.
- Energy efficient and environmentally sound transportation systems.
- People spend less time traveling and more time where they want to be.
- Infrastructure and services have been provided to meet the needs of a growing population as well as to correct existing deficiencies.

- Redmond in 2022 has maintained a very green character.
- Redmond has reached its ultimate size, having annexed all remaining territory in its Potential Annexation Area so that residents may receive a full range of urban services.
- Redmond is an integral member of the regional planning community.
- Though the City has experienced growth and change during the past 20 years, Redmond has maintained its distinctive character.
- Community gathering places are found throughout the City.
- Care has been given to preserve elements of the natural environment.
- The cost of maintaining Redmond's quality services and facilities is borne equitably.
- Many citizens actively participate.
- In 2022, as in 2003, Redmond is a community of good neighbors.

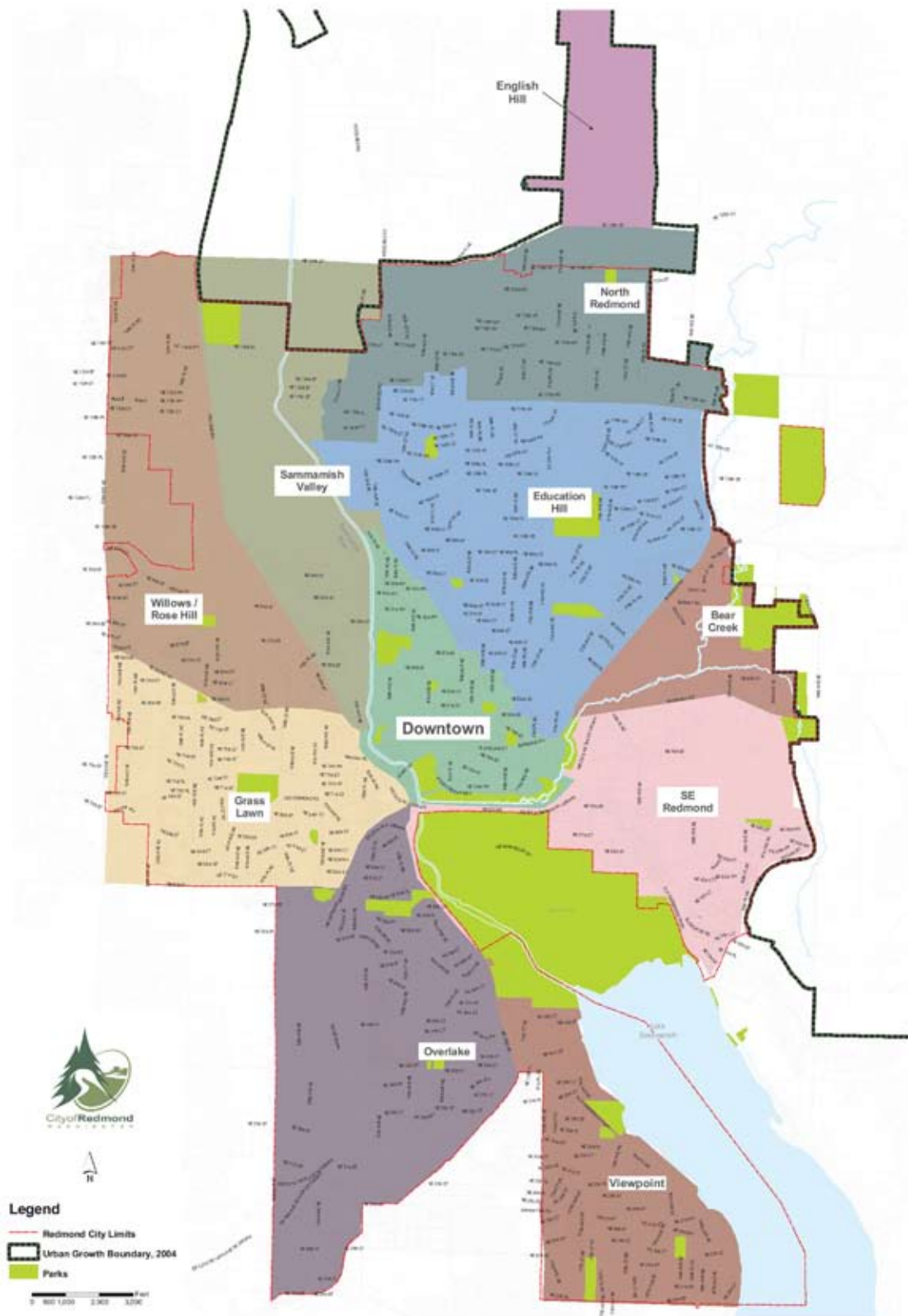
Regional Location Map



Sources: State of Washington, King County, and USGS

Approximate Scale in Miles
3 1.5 0 3

Map 1: Regional Location Map



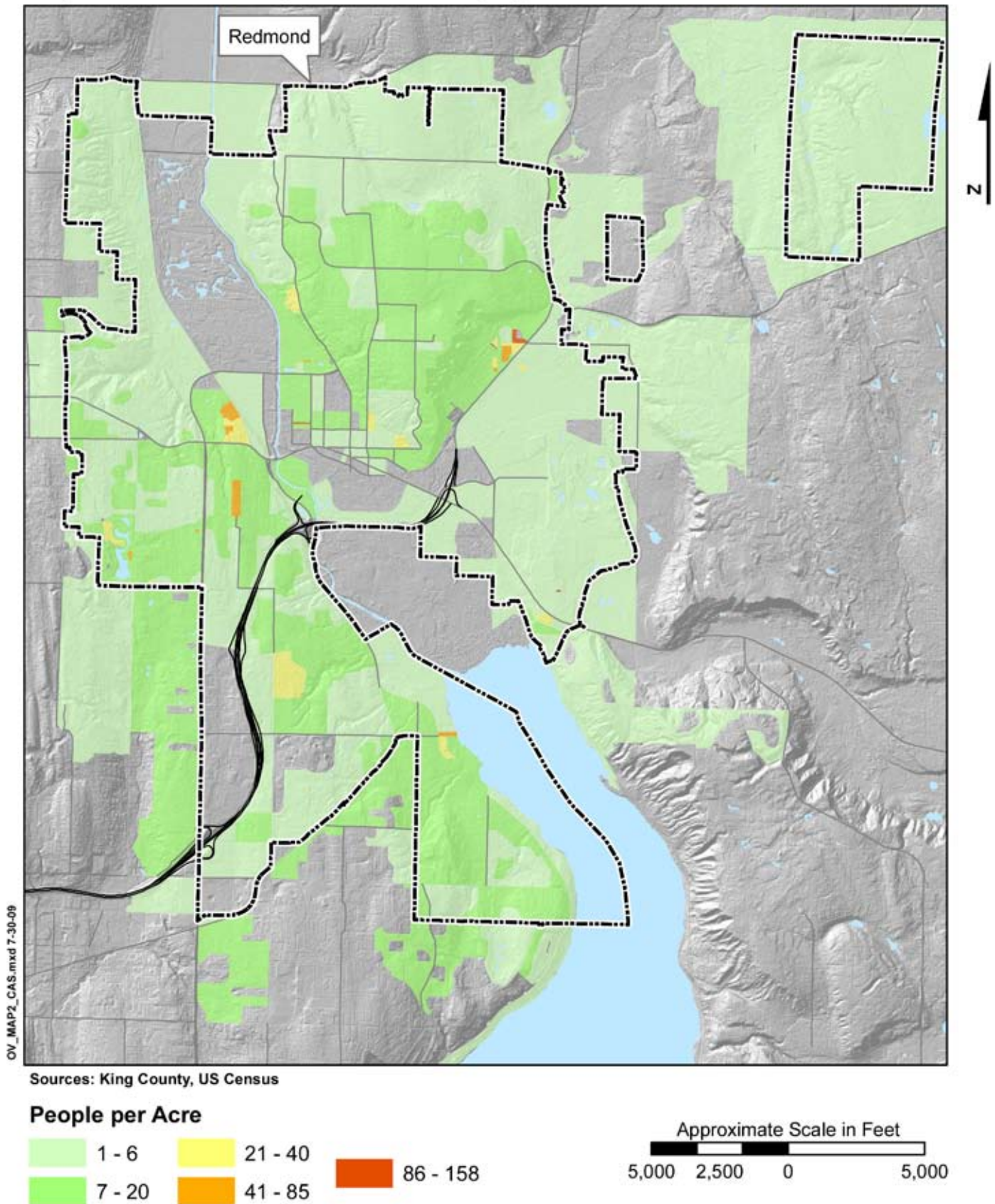
NEIGHBORHOODS City of Redmond

(generated August 2007)

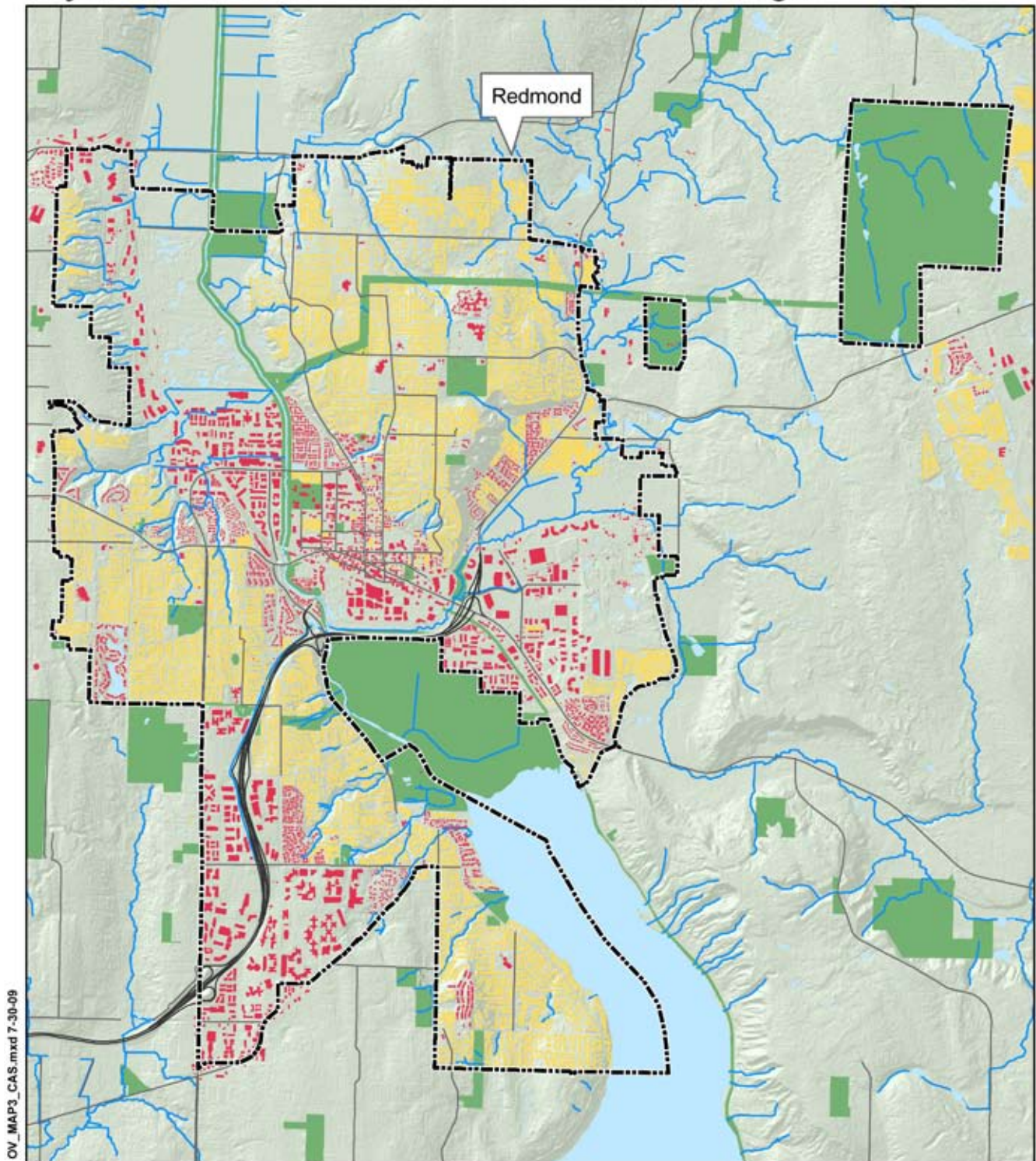
Map 2: City of Redmond Neighborhoods

Taken from: <http://redmond.gov/cityservices/maps/neighborhoods2007.pdf>

City of Redmond Population Density by Census Block



Map 3: City of Redmond Population Density by Census Block

City of Redmond Commercial and Residential Buildings

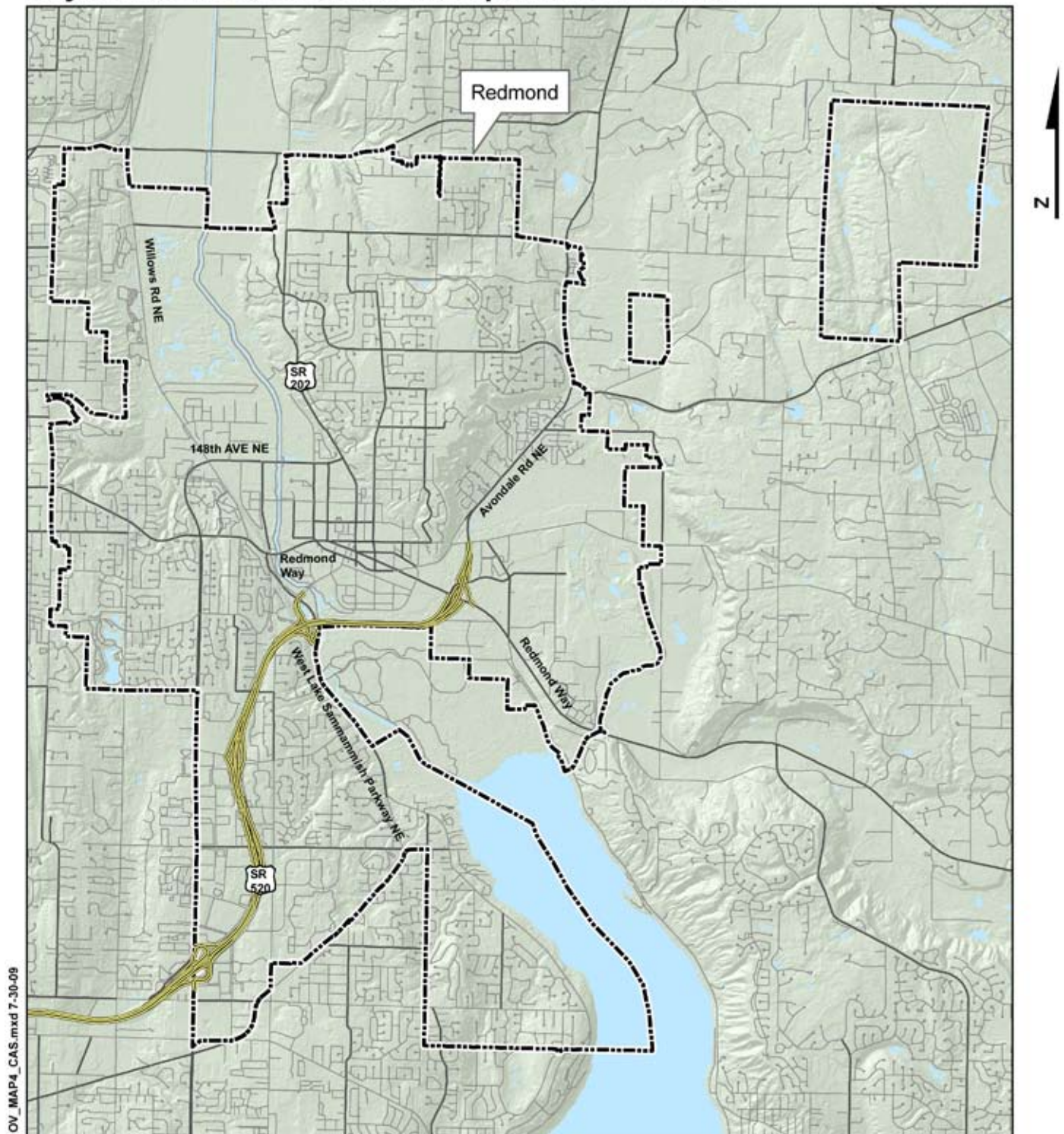
Source: King County

- Commercial Buildings
- Residential Buildings
- King County Parks

Approximate Scale in Feet

5,000 2,500 0 5,000

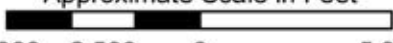
Map 4: City of Redmond Commercial and Residential Buildings

City of Redmond Motorized Transportation Network

Sources: King County, Redmond

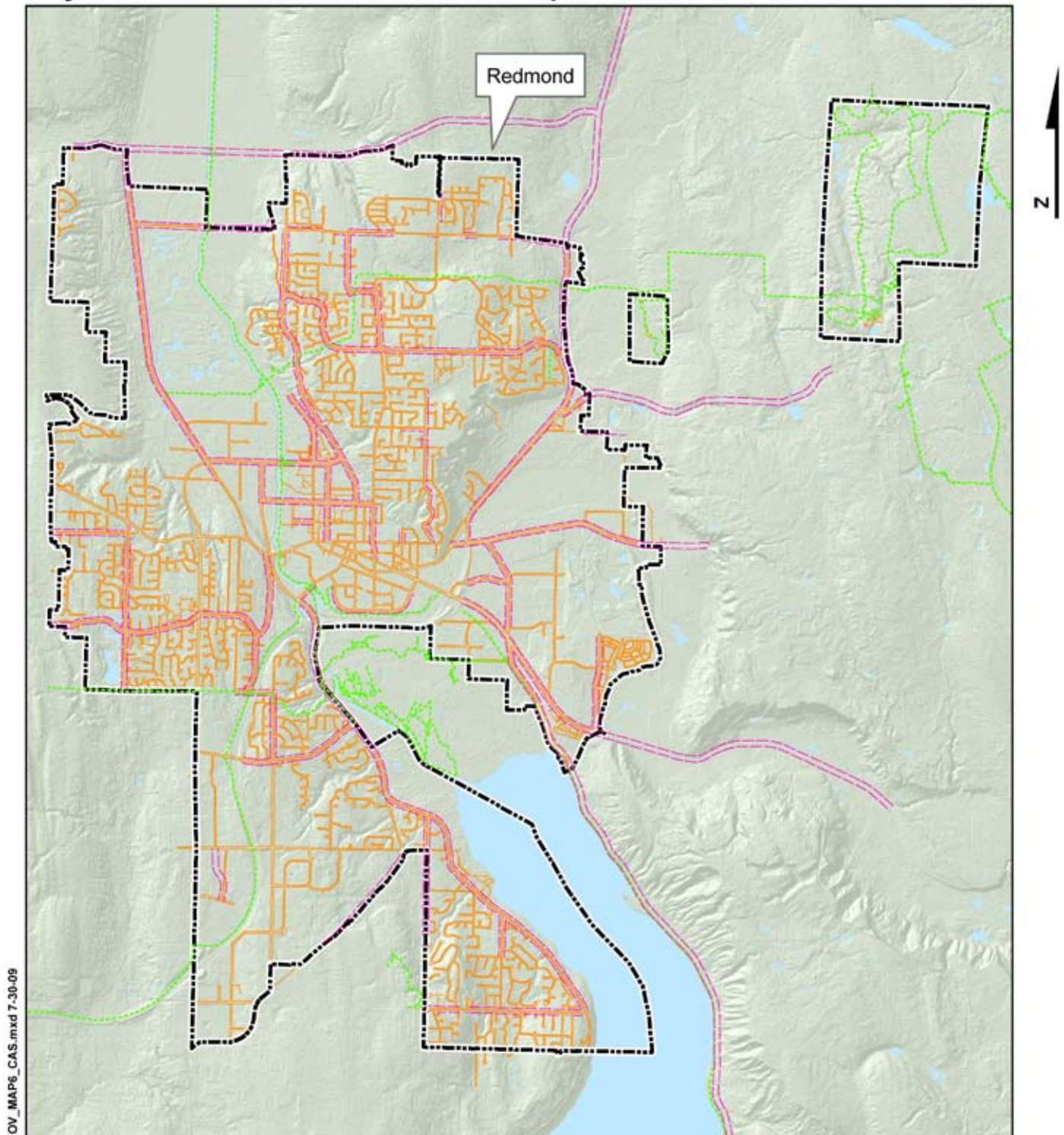
-  Freeway
-  Local Arterials
-  Main Arterials

Approximate Scale in Feet



5,000 2,500 0 5,000

Map 5: City of Redmond Motorized Transportation Network

City of Redmond Non-Motorized Transportation Network

Sources: King County, Redmond

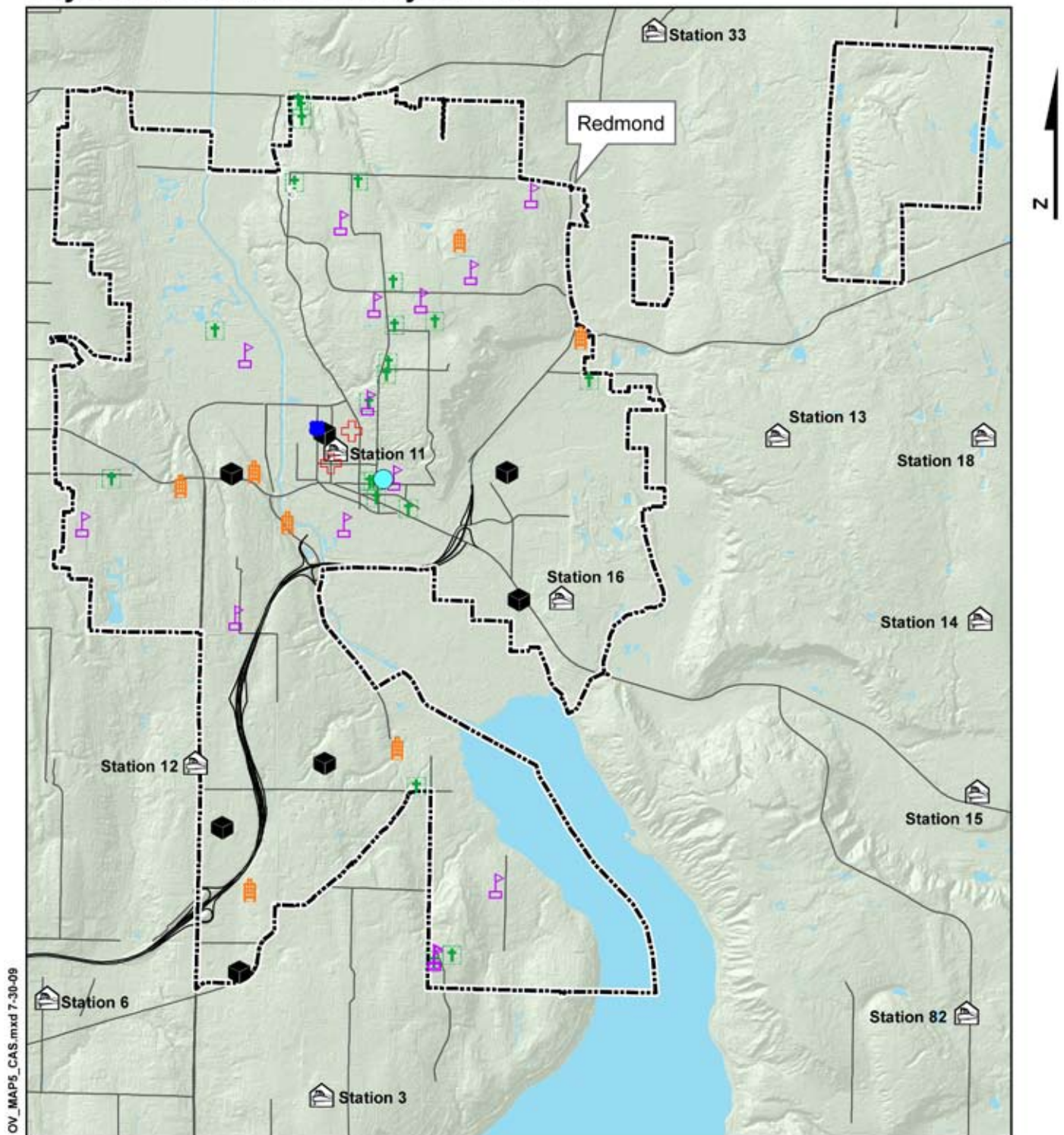
- Bicycle Lanes
- Trails
- Sidewalks

Approximate Scale in Feet

5,000 2,500 0 5,000

Map 6: City of Redmond Non-Motorized Transportation Network

City of Redmond Community Facilities



Sources: King County, City of Redmond



Map 7: City of Redmond Community Facilities

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This plan is an update of the 2004 City of Redmond Hazard Mitigation Plan (HMP). Although it is an update, this document has been redesigned so that it looks, feels, and reads differently than the original. This is due to several factors: new hazard information has become available that drives new definitions of risk, the City has matured and new capabilities are now available, and the new format will allow readers to more easily understand the content. In addition, the 2004 HMP included several action items that have been completed, creating an opportunity for developing new mitigation strategies.

The two main arenas for outside input in updating the Redmond Hazards Mitigation Plan were the Mitigation Implementation Committee (MIC) and public participation. The MIC process afforded the Project Team access to the knowledge of relevant professionals in Redmond. The public participation component used a public meeting, surveys, and public review to gain firsthand knowledge of local communities and get feedback throughout the process.

3.1 Mitigation Implementation Committee Process

The purpose of the Mitigation Implementation Committee (MIC) is to guide the Hazards Mitigation Plan update process. The Committee was comprised of one or more representatives from the Redmond Police and Fire Departments, the Planning Department, Redmond Parks and Recreation, and municipal agents charged with ensuring small business resilience in the community. There were three MIC meetings, held between March and May 2009.

The first meeting followed the initial phase of research. The Project Team presented data on potential hazards, Redmond's built environment, demographics, municipal capabilities, and the process of hazard mitigation planning. The main goal of the first meeting was to set the scope for the remainder of the project. Based on their experience and local knowledge, the MIC members narrowed the scope of research to the topics of greatest relevance to Redmond. This included ranking the particular hazards that should receive most attention during the update process.

The second MIC meeting was used as a forum for the Project Team to present ranked risk assessments of potential hazards. The process enabled MIC members to make informed decisions about selecting hazards for mitigation. The MIC feedback provided the Project Team with direction for one of its final phase tasks – the development of probable, worst-case hazard scenarios. Through a group participation exercise (a forced choice dot exercise), the Project Team discovered which mitigation strategies the MIC considered highest priority. The MIC also offered initial feedback on strategies

Planning Process FEMA Requirements

Requirement §201.6(b): In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:

- (1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
- (2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and
- (3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

Requirement §201.6(c)(1): The plan shall document the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

that may yield the greatest benefits for mitigation efforts.

During the final MIC meeting, the Project Team presented the final disaster scenarios and recommended mitigation strategies. Prior to this meeting, the proposed strategies had been presented to the public and amended, to reflect the public input. Following the final MIC meeting, suggested amendments from MIC members were incorporated. The resulting strategies were then used in the Hazards Plan update.

3.2 Public Process

In order to maximize the effectiveness of this HMP, the Project Team sought continual public engagement. The team reviewed the public engagement efforts of other jurisdictions and concluded that an aggressive and varied outreach strategy would be necessary to involve the public. The strategy aimed to solicit ideas and feedback from Redmond residents, employees, and business owners through multiple avenues.

Public input was encouraged during three phases of the document development. An online survey was available through the City of Redmond's web page from April 18th until June 15th, 2009. The web survey provided the Project Team with information about the community knowledge and perception of threats to the City. The second opportunity for involvement was at the public meeting, held in the City Hall on May 14, 2009. The public meeting provided more information about community knowledge and the existing vulnerabilities and capabilities. Finally, after the City of Redmond reviewed the HMP update, the document was available for public comment. The document was posted on the City's web page and at several locations with opportunities for anonymous feedback. Public input from all phases of the Plan development were incorporated into the final document.

3.2.1 Public Process Goals

The goal of the public process was to solicit "ground-level" information about Redmond. The intent was to gauge household and business preparedness and awareness of personal mitigation techniques, identify areas where people were particularly vulnerable, and get feedback on potential mitigation strategies. When possible, we provided respondents with information that would be useful in personal preparedness activities.

3.2.2 Questionnaire & Public Meeting Promotion

Several methods were used to inform the public about the opportunity to participate in the HMP update process. Utility mailer inserts were included in the May billing cycle (see Appendix A, Item 1). These mailers were included in all city-billed utilities, including water and wastewater treatment; therefore nearly all residents received the notification.

Similar fliers were passed out at the Redmond Saturday Market and the Redmond

Town Center on May 2, 2009. Fliers were also distributed at the Redmond Police & Fire Community Outreach Center. Targeted outreach was directed at identified stakeholders, particularly groups representing vulnerable populations, such as seniors and children. An email announcement was sent to the Redmond City email list.

Given the continuity challenges businesses face during hazardous events, the Project Team contacted the Redmond Chamber of Commerce CEO & President, and Director of Communications, Media and Events. We worked with those contacts to inform their members of the questionnaire and public meeting.

In consideration of the increased vulnerability of children and the potential for geographic isolation, administrators at many of the City's schools were contacted (see Appendix A, Item 2). In addition to the Lake Washington School District Director of Communications and the Lake Washington School District Community Relations & Communications Coordinator, the Project Team also contacted principals from:

- Louisa May Alcott Elementary School
- Emily Dickinson Elementary School
- Explorer Community School
- Benjamin Rush Elementary School
- Redmond Elementary School
- Rosa Parks Elementary School
- Albert Einstein Elementary School
- Norman Rockwell Elementary School
- Redmond High School
- Horace Mann Elementary School
- Redmond Jr. High School
- Faith Lutheran School
- Stella Schola Jr. High School
- John James Audubon Elementary School

Additional emails were sent to City of Redmond Neighborhood Liaisons, civic and community organizations, places of worship, and housing organizations. A variety of organizations were contacted including:

- Places of Worship: Overlake Christian Church, Meadowbrook Church, Faith Lutheran, and ten other faith based groups in the City
- Vulnerable Populations: Eastside Retirement Association, Redmond Senior Center
- Service Groups: Redmond Rotary, Redmond Lions, and Redmond Kiwanis
- Non-Profit Organizations: Including Habitat for Humanity of the Eastside, Hopelink, and Hopebuilders International
- Community Groups: Friends of Marymoor Park, Friends of the Redmond Library, Redmond Historical Society, and other general interest groups

Outreach messaging was sent to local area blogs, including:

- Experience Redmond (<http://www.experienceredmond.com/blog/>)
- Redmond Neighborhood Blog (<http://redmondcity.blogspot.com/>)
- Thinkspace (<http://www.thinkspace.com/blog/>)
- The East Side Life (<http://blog.theeastsidelife.com/wordpress/>)
- West Redmond Real Estate Buzz (<http://westredmondrealestatebuzz.com/>)

The blog Thinkspace posted a notice about the meeting and several questionnaire respondents reported that they found the questionnaire via the City of Redmond's list of online surveys, available at redmondcity.blogspot.com.

The questionnaire itself concluded with a reminder to attend the public meeting to receive and provide more information in the planning process. The meeting was also promoted via notice in The Redmond Reporter, the local weekly newspaper.

3.2.3 Public Meeting Activities

The Hazards Mitigation Public Meeting was held May 14, 2009 at the Redmond City Hall Bytes Café from 7:00 pm to 9:30pm. Tables were set up with information specific to the hazards faced by Redmond. Each table featured a simplified hazard map to allow residents to identify the risks faced by the homes, businesses, and transportation routes. Each table was staffed by a team "topic expert" to answer questions from participants. To help guide participants through the hazards information and encourage interaction with the displays, a meeting "passport" was created. See the Appendices for sample meeting materials and the agenda (see Appendix A, Items 3 - 5).

For review of the hazards displays, the presentation team delivered a brief summary of the hazards data, the relative risk rankings, and the purpose of hazards mitigation planning. The presentation was followed by a facilitated scenario exercise, in which participants were asked to review the anticipated effects of a crustal earthquake, and provide feedback on selected earthquake-related mitigation measures. Participants were asked to identify usually overlooked impacts and unidentified strategies, and select their preferred strategies. Scenario presentation materials are included in Appendix A, Item 3. Participant feedback was incorporated into the analysis of the mitigation strategies discussed below.

Despite comprehensive public outreach efforts, the meeting was sparsely attended; three residents attended the meeting, and only one was able to attend the presentation and scenario exercise.

3.2.4 Questionnaire Results

The questionnaire was developed using the University of Washington's Catalyst software. The City of Redmond posted a link to the questionnaire on the City's website, which remained active until June 15, 2009. Complete tables of results are available in Appendix A, Item 6.

Demographics

In total, 85 people responded to the Redmond Hazards Mitigation Questionnaire. Of these, 45 live in Redmond, 9 work in the city, and 31 both live and work in the City. The majority of respondents (82%) were between the ages of 30 and 59. Fifty-nine percent of respondents reported an annual income of \$90,000 or more.

Ranked Concerns of Hazards

Respondents were asked to rank the five potential hazards that most concerned them. A simple weighting technique produced the following results, in order of most concerned to least concerned:

1. Earthquake
2. Winter storm
3. Pandemic
4. Flood
5. Terrorism
6. Hazardous material spill/exposure
7. Wildfire
8. Drought
9. Landslide
10. Other hazards
11. Heat wave

Concern for earthquakes and winter storms far exceeded concerns for the other hazards listed.

Resident information sources and preparedness

Residents were asked questions about where they learned to prepare for hazards. The most common response was local government, television and radio broadcasts, newspapers, and through the Red Cross or similar agencies.

When asked to identify the most effective source of hazards information, 15% of respondents chose local government, followed by newspapers (12%), and television and radio broadcasts (12%). Other sources identified by respondents as the most effective included internet resources and common sense.

Residents were also asked to list the steps they had taken to prepare for disasters. Responses were as follows:

Steps taken	Number of responses	Percentage
Smoke detectors	73	96.1%
Flashlights	73	96.1%
Battery-powered radio	62	81.6%
Fire extinguisher	65	85.5%
Spare batteries	63	82.9%
Secured water heater	56	73.7%
Stored extra food	57	75.0%
Stored extra water	54	71.1%
Located utility shut-offs	51	67.1%
Stocking extra medical supplies/prescriptions	38	50.0%
Fastened home to foundation	32	42.1%
First Aid/CPR certification	30	39.5%
Supply kit	31	40.8%
Fire escape plan	21	27.6%
Family communication plan	24	31.6%
Secured tall furniture	21	27.6%
Moved heavy objects	15	19.7%
Other	5	6.6%
None	0	0.0%

Table 5: Redmond Resident Disaster Preparation Steps

Respondents described their preparedness as follows:

Level of preparedness	Number of responses	Percentage
Highly prepared	12	14.1%
Somewhat prepared	52	61.2%
Somewhat unprepared	17	20.0%
Highly unprepared	4	4.7%
Not sure	0	0.0%

Table 6: Redmond Resident Disaster Preparedness Levels

Residents and special needs

Nearly half of the residential respondents indicated they had children at home. Fifteen percent reported living with a senior citizen. One in twelve lives with people for whom English is a second language, and 3% live with someone with a physical disability.

Work-in-Redmond preparedness information

Respondents who work in Redmond were asked to identify steps their employers have taken to prepare or mitigate for hazards. The results are as follows:

Preparation	Number of responses	Percentage
Trained employees in preparedness and response	21	52.5%
Conducted emergency drills	20	50.0%
Created evacuation plans	20	50.0%
Identified vital records and protected computer data and equipment	15	37.5%
Established communication plans to communicate with employees, vendors, customers, and the media.	15	37.5%
Offsite/out of area back up of computer files and physical papers	12	30.0%
Prepared sources of emergency power to support critical operations and secure records	12	30.0%
Provided employees with information to prepare for disasters at their homes to enable them to return to work sooner	11	27.5%
Conducted hazard vulnerability analyses of all buildings	10	25.0%
Encouraged and tracked annual influenza vaccination for employees	10	25.0%
Made sure insurance covers business equipment and supplies	8	20.0%
Other	6	15.0%
Set up an emergency cash reserve	5	12.5%
Created an emergency supply kit with food, first aid, and other supplies.	5	12.5%
Developed and planned for scenarios likely to result in an increase or decrease in demand for your products and/or services during a pandemic	5	12.5%
Determined potential impact of a pandemic on company business financials	4	10.0%
Purchased business interruption insurance	4	10.0%
Shared best practices with other businesses in your communities, chambers of commerce, and associations to improve community response efforts	4	10.0%
None	3	7.5%
Stored enough drinking water for employees and customers	3	7.5%
Anchored office equipment, production equipment, and warehousing facilities	3	7.5%
Practiced table-top exercises	2	5.0%
Replaced windows with shatterproof glass	2	5.0%
Trained and prepared ancillary workforce (e.g. contractors, employees in other job titles/descriptions, retirees)	1	2.5%

Table 7: Disaster Preparedness of Redmond Businesses

It is difficult to determine from these numbers whether or not employers have taken steps to mitigate hazards at their workplaces, or whether the lower numbers reflect a lack of respondent knowledge of the steps their employers have taken.

When asked to identify strategies for helping their employer prepare for or mitigate hazards, respondents answered as follows:

Strategy	Number of responses	Percentage
Business-oriented disaster planning	17	42.5%
None	12	30.0%
Mitigation incentives	9	22.5%
Tax breaks	9	22.5%
Recovery grants	6	15.0%
Flood risk info	8	20.0%
Recovery loans	3	7.5%
Business helpline	3	7.5%
Flood repair info	5	12.5%
Financial literacy	2	5.0%
Other	3	7.5%

Table 8: Business Preparedness Strategies

Overall, about half of respondents who work in Redmond (53%) believe their employer is prepared for hazards the City could experience. Seventeen percent believe their employer is unprepared, and the remaining 30% are not sure.

Businesses and special needs

Two-thirds of respondents indicated they share a workspace with a person with physical disabilities. Two-thirds also indicated working with people for whom English is not their primary language. Forty-five percent indicate sharing a workspace with a senior citizen.

Overall strategies

Respondents were asked to point to the relative value, in terms of the city's time and resources, of six broad categories of mitigation strategies. A simple weighting system assigned a score to each category that could be used to compare their relative value to the public.

The most popular category of mitigation strategies was emergency services, followed by mitigation actions on future development, public education and awareness strategies, protection of natural processes, structural projects, and mitigation actions on existing development.

Outreach

Respondents were asked to explain where they first heard about the questionnaire. Fifty-two percent of respondents had received a flyer in their utility bill, 18% had seen the link on the city's website, 9% had heard of the questionnaire from members of the Project Team, and 4% from word-of-mouth. The remaining 18% described other means by which they had heard of the questionnaire, including blogs and a homeowners' association newsletter.

3.2.5 Document Review

After the Project Team completed the final draft of this HMP update, it was sent through several review phases. The public was given the opportunity to comment on the HMP, prior to sending it to the State and FEMA for approval. The document was available on the City of Redmond's web page and at public locations. Physical copies of the document were available at City Hall and the Public Library. Residents were able to give anonymous feedback through a survey. The comments from the survey were incorporated in the final document.

The document review process followed the schedule below:

July 15th, 2009 - August 13th, 2009: City of Redmond Department Review

August 14th, 2009 - September 14th, 2009: Public Review and Washington State Review

September 15th, 2009: FEMA Approval

3.3 History of Hazards in Redmond

Storm history, evidenced by the Winter Storms of 1993 and 1996-97, the Columbus Day Storm of 1993, and the Inaugural Day Storms of 1962 and 1993, suggests a high probability of repeat occurrence in the City of Redmond and the Puget Sound region. The potential exists for damage from falling trees, hillside slippage and storm water related flooding, to name a few possibilities.

Although the 2001 Nisqually earthquake could be felt as far south as Oregon and as far north as Vancouver B.C., Redmond did not suffer extensive damage but minor liquefaction did occur to the north and south of the City limits.

There is no history of serious epidemic disease in Redmond in recent times. Nonetheless, the King County Health Services Communicable Disease Center warns that in the presence of a growing population, there is more opportunity for infectious disease to occur and spread. In the last ten years, the population of Redmond has increased 26.4%. As such, there is reason to believe that the probability of an epidemic in Redmond is proportional to the increase in population. The probability of epidemic from a mild form of influenza virus is high, while the probability of a severe form of the influenza virus is low.

In the case of Redmond, the elevation of the 100-year flood plain is approximately 12 inches higher in elevation than those areas outside of the flood plain. Few locations along the Sammamish River are vulnerable to flooding, except in the instances of backwater flooding. The area most commonly affected by backwater flooding is beneath the railroad tracks along Redmond Way. This area flooded during the heavy snows and subsequent melt-off related to the winter storm of 1997. At that time, four lanes of Redmond Way were closed, and traffic through the area was diverted to other streets.

The January 1997 storm also shut down five streets because of flooding. A hazard associated with that storm was a 200-foot-long mudslide that forced the evacuation of 35 residents along 180th Avenue Northeast. The slide cut off the only road to seven houses in the area and prompted the evacuation of nearby condominiums. (For more information on this storm see Landslides, Chapter 8).

In February of 1996, Patterson Creek east of Redmond cut a new path, spilling over its shallow banks and roaring across the Redmond-Fall City Road. In November of 1998, East Lake Sammamish Parkway Northeast, south of Redmond, remained closed after rainfall and a broken water main caused part of the road to drop into a 25-foot sink hole on Friday. King County transportation crews worked through the night to stabilize the road so it could be repaired. While there is a history of flooding and other hazards associated with severe precipitation, these events are not anticipated on an annual basis. Indeed, they are due to exceptional weather conditions (except in the case of Bear Creek, where annual flooding is anticipated). As such, the probability of flooding in Redmond can be assigned the following values: a low probability of flooding on the Sammamish River, a high probability of flooding for Bear Creek, and a low probability of flooding for Lake Sammamish.

Each of these storms has led to a thorough investigation of response and mitigation procedures in Redmond. Some of the changes implemented as a result of these reviews include site location and storm debris collection and disposal, traffic signal monitoring and backup power supply, tree trimming and removal, storm drain maintenance and street clearing procedures, and rehabilitation of existing stream corridors.

Presidential Disaster Declarations in Redmond

Storms are not uncommon to the City of Redmond due to the City's proximity to the Puget Sound, Pacific Coast, and Cascade Mountains. All the storms listed below received presidential declarations with the exception of the January, 1993 event. This storm consisted of high winds, rain, and small amounts of snow. It knocked out power to more than 600,000 residents within the region causing former governor Lowry to declare a state of emergency.

- November, 1990 – Severe Storm
- January, 1990 – Severe Storm
- March, 1991 – Severe Storm
- January, 1993 – Inaugural Day Wind Storm
- March, 1993 – Severe storm, High Winds
- October, 1993 – Columbus Day Wind Storm
- January, 1997 – 1159-DR-WA (Flood, Landslide)
- February, 2001 – 1361-DR-WA (Earthquake)
- December, 2006 – 1682-DR-WA (Windstorm)
- December, 2008 – 1825-DR-WA (Snowstorm)
- January, 2009 – 1817-DR-WA (Flood)

In addition, Redmond was struck by a landslide in December 2001, as a result of substantial rainfall that caused a hillside to slough.

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Identification and Profiling of Hazards

This plan is an update of the 2004 City of Redmond Hazard Mitigation Plan (HMP). Although it is an update, this document has been redesigned so that it looks, feels, and reads differently than the original. This is due to several factors: new hazard information has become available that drives new definitions of risk, the City has matured and new capabilities are now available, and the new format will allow readers to more easily understand the content. In addition, the 2004 HMP included several action items that have been completed, creating an opportunity for developing new mitigation strategies.

It is critical that risk assessment, mitigation and preparedness efforts are founded on accurate information. This section of the plan assess the potential threats to the City of Redmond – earthquakes, severe storms, flooding, wildfires, landslides, pandemics, heat waves, droughts and hazardous materials spills – and the corresponding vulnerabilities. The risks have been identified based on historical events and available information about changing conditions. Changes in land use and climate change were researched in order to provide a valuable assessment of how these risks may vary from the historical patterns.

The City of Redmond and King County GIS databases were used to determine the potential impact of each hazard on the critical infrastructure and city services. Historical data and climate change predictions were used to identify the likelihood that the identified hazards would affect Redmond in the future.

The first round of screening looked at a wide variety of hazards that are probable in the United States. Through this screening, the project team identified the significant risks for Redmond. The Risk Assessment Model (described below) was used to determine the relative risk of each hazard based on the location, frequency and vulnerabilities. Three likely scenarios were written in order to illustrate the probable sequence of events. In order to understand the likely risks, each hazard was profiled considering the location, timing/duration, severity, frequency, vulnerabilities and future planned development.

Risk Assessment FEMA Requirements

Requirement §201.6(c)(2): Plan content.

The plan shall include the following:

(2) A risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Hazards Screening for the City of Redmond		
HAZARD	RISK	WHY / WHY NOT
Avalanche	None	Does not affect City
Coastal Erosion	None	Does not affect City
Coastal Storm	None	Does not affect City
Drought	Low Risk	Risk may increase in future with climate change
Earthquake – Crustal	High Risk	Low frequency, highly destructive
Earthquake – Benioff	High Risk	Moderate frequency, moderately destructive
Earthquake – Subduction	High Risk	Low frequency, highly destructive
Extreme Heat	Low Risk	Risk may increase in future with climate change
Flood	High Risk	Risk may increase in future with climate change.
Hazardous Material Spill	Low Risk	Hazardous Materials are highly regulated
Hurricane	None	Does not affect City
Landslide	Low Risk	Risk may increase in future with climate change and increased development
Pandemic	Low Risk	Risk may change or increase in future with climate change and globalization
Seiche	Low Risk	May be a secondary hazard (addressed as part of landslides)
Tornado	None	Does not affect City
Tsunami	None	Does not affect City
Volcano	None	Does not affect City
Wildfire	Low Risk	Risk will increase in future with climate change
Winter Storm	High Risk	Risk will increase in future with climate change

Table 9: Hazards Screening for the City of Redmond

Significant Risks

- Benioff Earthquake and Liquefaction
- Severe Storms
- Floods
- Crustal / Subduction Earthquakes and Liquefaction

Less Significant Risks

- Landslide
- Drought

Risks Monitored by an Outside Agency

- Pandemic (WHO and CDC)
- Hazardous Materials Spill (EPA)

Emerging Risks Due to Climate Change

- Wildfires
- Heat Wave

The City of Redmond is exposed to a number of natural hazards that vary in potential intensity and impact on the City. This plan addresses four hazards that pose a significant threat and six that pose limited threats. Of the six that pose limited threats, two are primarily monitored by an outside agency and two are emerging risks that are likely to pose a greater threat to Redmond in the future.

Risk Assessment FEMA Requirements

Requirement §201.6(c)(2): Plan content.

The plan shall include the following:

(2)(i) A description of the type, location, and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Hazards were included in the plan based on the likelihood of occurrence and the potential impact on the City.

Vulnerabilities considered include people, buildings, systems, the local economy, and the natural environment. Although heat related hazards do not currently present a significant hazard in Redmond's mild climate, climate change predictions indicate that these hazards may be more significant in the future. In addition to considering the hazards independently, the plan addresses the likelihood that one event may trigger secondary hazards or exacerbate existing conditions.

The hazards included in this plan were identified through academic research and community input. The MIC (Mitigation Implementation Committee) provided local expertise and historical knowledge to the Project Team, which subsequently conducted extensive research. The list of hazards includes all those that pose a potential risk to the City of Redmond.

Risk Assessment Model

In order to comprehensively assess the relative risk posed by hazards, the Project Team developed a model that considers both the frequency and vulnerability to the hazards. The objective of the rating system is to identify which hazards pose the greatest risk to the City of Redmond. In order to comprehensively assess the relative risk, the model considers the frequency and the vulnerability of each hazard. The model deals with hazards and risk in a relative manner and the risk rankings are to be considered within this context. Frequency and vulnerability were given equal weighting. Specifically, the model uses the following simplified equation:

$$\text{Risk} = \text{Frequency} \times \text{Vulnerability Factor}$$

Frequency

The hazard frequency was determined for each hazard using a 0-3 scale:

0	Hazard is unlikely to ever occur in Redmond
1	Hazard may occur once in a generation
2	Hazard may occur every ten to fifty years
3	Hazard will occur with some regularity

Vulnerability Factor

A vulnerability factor was used to address the various vulnerabilities and the severity of a hazard. The built environment, systems (transportation, utilities, economy, etc.), natural systems, the human population and severity were each assigned a zero to three value. In order to equally weight frequency and vulnerability, the average of the vulnerabilities provided a “vulnerability factor.” The vulnerability ratings used the following equation:

$$\text{Vulnerability Factor} = (\text{Human} + \text{Built} + \text{Natural} + \text{Systems} + \text{Severity})/5$$

The vulnerability factor was then classified on a 0-3 scale:

0	The vulnerable population or system will not be affected
1	Event causes some mild disturbances to some systems, buildings, natural environment or populations
2	Event causes some mild disturbances to all systems, buildings, natural environment or populations OR event causes severe disturbance to some systems, buildings, natural environment or populations
3	The entire City is significantly affected by the event

Based on the information provided about each of the hazards, the assessment used the following equation to complete the Hazard Rating Chart:

$$\text{Risk} = \text{Frequency} \times ((\text{Human} + \text{Built} + \text{Natural} + \text{Systems} + \text{Severity})/5)$$

Due to the variability inherent in each of the hazards and the rating system, the risks were divided into categories of low, moderate and high-risk hazards. The relative ranking established by this model provided a framework for the risks and strategies addressed in the Hazards Mitigation Plan.

The hazards ranked in 2004 have changed only slightly in 2009. Severe storms and earthquake remain the primary hazards Redmond must be concerned with. Climate change has been incorporated into the risk assessment in 2009 and that has resulted in a little shifting of the order of hazards. The biggest change has come with the rise of epidemic/pandemic on the list. In 2004, pandemic ranked eighth out of ten items. In 2006, pandemic was listed second on the hazards list. In 2009, it ranks at the top of the lower half of the list.

Table 10, Redmond Risk Assessment Model, shows the Risk Assessment as applied to the hazards applicable to Redmond.

Event	Frequency	Vulnerability					Vulnerability Factor	Risk Rating	Risk Level
		Built	Natural	Systems	Population	Severity			
Possible Rankings	0 - 3	0 - 3	0 - 3	0 - 3	0 - 3	0 - 3	0 - 3	0 - 9	Low-High
Severe Storms	3	1	1	3	2	2	1.8	5.4	High
Benioff Earthquake	2	2	1	2	2	2	1.8	3.6	High
Floods	2	2	2	1	1	2	1.6	3.2	High
Crustal / Subduction Earthquake	1	3	1	3	3	3	2.6	2.6	High
Wildfire	1	2	2	1	1	2	1.6	1.6	Low
Landslide	1	2	0	2	1	2	1.4	1.4	Low
Pandemic Mild	2	0	0	0	2	1	0.6	1.2	Low
Pandemic Catastrophic	1	0	0	0	3	3	1.2	1.2	Low
Heat Wave	1	0	2	0	2	2	1.2	1.2	Low
Drought	1	0	2	1	2	1	1.2	1.2	Low
Hazardous Materials	1	0	1	1	0	2	0.8	0.8	Low

Table 10: Risk Assessment Model

Scenarios

Scenarios provide a narration of events that are likely to occur in Redmond. Each scenario considers the threat of the hazard and the probable subsequent events that will occur based on the current conditions. Three scenarios were developed to look at regional, municipality-wide and localized events. These scenarios were developed to help illustrate identified vulnerabilities and facilitate public participation. The HAZUS software package produced by FEMA was used to predict the impacts of Scenario 1: Crustal Earthquake.

Scenario 1: Crustal Earthquake¹⁶

At 1:38pm on March 18th a 6.7 magnitude earthquake occurs along the Seattle fault. The epicenter is located within two miles directly south of Redmond. Peak Ground Acceleration (PGA) ranged from 0.35 in the Northern end of the City to as high as 0.51 in the Southern edge of the City. The massive shaking caused over \$980 million of damage and 57 casualties.

The magnitude of the earthquake was similar to the 2001 Nisqually earthquake, but the violent ground shaking caused much more damage. The earthquake caused damage to 5,547 of the City's 17,000 buildings. 271 of those buildings are damaged beyond repair. 47 of the 52 unreinforced masonry buildings were at least moderately

¹⁶ Scenario and damage is based on HAZUS run of 6.7 magnitude earthquake on the Seattle Fault. The region was defined as the main census tracts within the City of Redmond. Consequently, the numbers of buildings, population, etc. are not completely consistent with City specific data.

damaged. The total cost of damages to the buildings exceeded \$806 million. Transportation systems within the City of Redmond also sustained damage. Two bridges were damaged, but one regained functionality after the day of the event. The total cost of damage to the transportation system was over \$30.2 million. Regional transportation failures, such as the collapse of the SR 520 bridge, limited Redmond's access to regional facilities that were already overwhelmed.

Lifeline utilities were also damaged. On the day of the earthquake, 231 leaks and 58 breaks in the water lines left over 8000 households without access to potable water. Service was promptly restored within 72 hours. Additional leaks and breaks in the wastewater sewer lines caused additional complications.

11,501 households lost electricity. Within a week, only 2,367 households remained without power. By April 18th only 406 households were still without electricity.

In addition to the immediate damage of the earthquake, fires broke out across the City and caused an additional \$13 million of damages. The five small fires burned less than a tenth of a square mile and displaced 148 people.

The biggest problem has been the lack of a local medical facility and the fact that the regional hospitals were overwhelmed. There were 620 people who suffered minor injuries that did not require hospitalization. Another 177 suffered non-threatening injuries that did require hospitalization. There were 29 people who had serious injuries that required immediate care. The earthquake caused 57 fatalities.

Scenario 2: Winter Storm

Snow began falling heavily at 1 a.m. on January 7th and continued in periodic showers for 8 days, depositing a total of 2 feet of precipitation. When the snow stopped on January 15th, the accumulation on uncleared roads averaged 10 inches, with drifts up to 3 feet. The snow and sleet covered the streets with icy snow patches. Sidewalks were invisible under the snow and there were several instances of pedestrian and vehicular paths crossing, resulting in 36 minor accidents and 5 major accidents with 3 traffic-related fatalities. The City's power grid had several temporary shutdowns and repairs, but was consistently off from midnight on January 13th to 3 p.m. on January 15th. Emergency call volumes during this period were very high, with the majority of calls requiring the evacuation of elderly homeowners to hospitals in Bellevue.

High volumes of snowfall caused ceiling leakage and some buckling on 36 commercial and office buildings with flat roofs, causing approximately \$1 million in damaged equipment and repair costs. Storm drains overflowed in several areas from debris, snowpack, and frozen water, and an ice jam on the Sammamish River flooded parts of West Lake Sammamish Parkway NE at the 520 off ramps, causing major traffic delays for 8 hours on the 14th. Many citizens were unable to drive and large numbers of businesses were closed for several days. Roads that were cleared were congested with triple the usual numbers of traffic due to impassible roads elsewhere. A family

of four died of carbon monoxide poisoning after bringing a generator into their home, and 10 house fires from candles and woodstoves caused above the usual amount of damage, due to delayed response times caused by poor road conditions. Businesses in the food industry, particularly grocery stores, discarded over 6 tons of rotting perishables. The loss of electricity compromised the most common of communication systems, making standard lines of communication unavailable, including RCTV and the internet. Several businesses sought additional loans to cover company-wide vacation time and loss of revenue and inventory; three small businesses declared bankruptcy.

Scenario 3: Landslide

At 10 p.m. on November 5th, after several weeks of rain, a section of hillside in the Education Hill area gave way. Three homes slid fifty feet down the hillside, depositing debris in the backyards of several other homes, which were not damaged directly but lost landscaping and auxiliary structures (e.g. storage sheds). The residents and the City are cleaning up the large amounts of debris. Five people were injured, but there were no life-threatening injuries. Although neighboring homes are currently stable, monitoring will continue as the section that gave way continues to occasionally crumble. The road above the hill has been closed due to instability. The debris blocked a culvert at the bottom of the hill and caused two feet of flooding on sections of SR-202, Redmond-Woodinville Road. The road was closed for thirty-six hours before crews were able to restore normal traffic flow.

Climate Change

Governor Gregoire and the State of Washington, in recognition that our climate is changing and the impacts of the expected changes could be profound, have instructed us to significantly reduce the State's contributions to climate change. - *Washington Climate Change Challenge (Executive Order 07- 02)*.¹⁷

In the report "The Preparation and Adaptation Working Groups" (PAWG) our Governor is asking us to incorporate climate change and its impacts into planning and decision-making processes. Accordingly, this Plan will address the impacts of climate change.

As a result of extensive research done by the International Panel on Climate Change and University of Washington Climate Impact Group¹⁸, we know that Washington's climate is changing, and the impacts of these projected changes will be far reaching. Although our state is working to significantly reduce its contributions to climate change, some changes cannot (or will not) be prevented. For Redmond, expected changes include:

- Hotter, drier summers
- Wetter winters with increasing rainfall and rain intensity
- Increases in weather extremes
- Secondary hazards include increased chance of wildland/urban interface fires, heat waves, insect infestation, drought, potable water shortages, flooding, erosion and landslides.

Scientists expect the Pacific Northwest climate to warm approximately 0.5°F every ten years over the next several decades. This rate is more than three times faster than the warming experienced during the twentieth century. In Washington, scientists project that average annual temperatures will be 1.9°F higher by the 2020s when compared with the 1970-1999 average, and 2.9°F higher by the 2040s. Changes in total precipitation are not projected to be significant over that time period; however, patterns of precipitation will change. Winters will bring more rain and less snow in the mountains.¹⁹

These projections are based on calculations that take into account human contributions to the accumulation of greenhouse gasses. Being human-caused, these projections could be tempered, should efforts be made at reducing greenhouse contributions.²⁰ While such efforts could slow warming, the impacts would continue for some time.

¹⁷ http://www.governor.wa.gov/execorders/eo_07-02.pdf

¹⁸ Global Climate Change Impacts in the United States, Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, (eds.). Cambridge University Press, 2009.

¹⁹ Ibid.

²⁰ http://www.governor.wa.gov/execorders/eo_07-02.pdf

Severe Storms Risk Assessment

This plan is an update of the 2004 City of Redmond Hazard Mitigation Plan (HMP). Although it is an update, this document has been redesigned so that it looks, feels, and reads differently than the original. This is due to several factors: new hazard information has become available that drives new definitions of risk, the City has matured and new capabilities are now available, and the new format will allow readers to more easily understand the content. In addition, the 2004 HMP included several action items that have been completed, creating an opportunity for developing new mitigation strategies.

4.1 Identifying Severe Storm Hazards

Severe local storms are categorized by atmospheric disturbances, with cold temperatures and various forms of precipitation. In Redmond's typically mild climate, irregular severe storms include high winds, freezing rain, sleet, heavy snowfall or hail. Some severe storms are accompanied by thunder and lightening. Since Redmond is not mountainous, six or more inches of snow in a 24-hour period is considered severe.

The following list shows the number of days with measurable amounts of snow and rain in the previous eight years in the City of Redmond.²¹ A measurable amount of precipitation is at least 0.01" of rain and ice or 0.1" of snow.

Annual Counts of Days with Measurable Snow and Rain		
Year	Snow	Rain
2008	10	175
2007	7	190
2006	4	186
2005	3	174
2004	3	167
2003	2	180
2002	7	160
2001	0	182
2000	5	166
1999	0	183

Table 11: Annual Count of Days with Measurable Snow and Rain

Source: Office of the Washington State Climatologist, Temperature data from 1999-2008, Courtesy of Karin Bumbaco, Assistant State Climatologist.

The trajectory of these systems determines the local effect. Storms with a southern origin bring heavy rain. Storms coming from the north bring cold air and the potential for snow and ice. Any winter storm, regardless of its trajectory, can be accompanied by high winds. Storms with sustained winds above 30 mph generally cause low impact, widespread damage, while winds above 50 mph are powerful enough to

²¹ Office of Washington State Climatology. <http://www.climate.washington.edu/climate.html>

cause significant damage.

Climate change predictions indicate that storms in the Northwest are likely to occur more frequently and be more severe. Although Redmond does not typically experience more than a week of snow each year, it is likely that these events will become more common. Redmond can expect to receive more ice and snow in the winter months.

4.2 Profiling Severe Storm Hazard Events

A. Location

The entire City of Redmond may be affected by a severe storm; however, microclimates within the City may increase the vulnerability in specific areas. Narrow culverts are vulnerable to ice jams and hilltops are subject to lightning. The hill and valley topography creates several wind tunnels. Steep slopes increase the likelihood that Rose Hill and Education Hill will experience more adverse effects of a severe storm.

B. Timing and Duration

Most severe storms in Redmond occur between November and April when the jet stream²² moves over the West Coast, and Pacific low-pressure systems are more frequent.²³ Storms can last anywhere from a few hours to several days. Weather forecasting abilities will provide Redmond, at minimum, a few hours warning prior to an extreme weather event.

C. Severity

Storms in Redmond are likely to have a severity of low to moderate. Historically, storms have been relatively short in duration and have had mostly localized impacts. The main concern about a severe storm in Redmond is the potential to isolate citizens and businesses if roads are blocked by snow or ice. This may cause some financial hardships for the City, but it is unlikely to cause widespread, permanent damage or loss of life.

D. Frequency

Although Redmond does experience some days with temperatures below freezing and receives some snow, severe weather is not typical of Redmond winters. The proximity to the Puget Sound keeps the climate moderate, with some incidents of snow. Over the last 20 years, Redmond has experienced an average 3.1 inches of snow per year. During that period, the most snow recorded in one month was 17.9 inches. There has not been a month with an average daily minimum temperature below freezing.²⁴

²² Jet streams are relatively narrow bands of strong wind in the upper levels of the atmosphere. The winds blow from west to east in jet streams but the flow often shifts to the north and south. Jet streams follow the boundaries between hot and cold air. Since these hot and cold air boundaries are most pronounced in winter, jet streams are the strongest for both the northern and southern hemisphere winters.

²³ National Weather Service, "JetStream - Online School for Weather," <http://www.srh.noaa.gov/srh/jetstream/global/jet.htm>.

²⁴ Western Regional Climate Center, "National Weather Station 457470 for period 1986 to 2000," <http://www.wrcc.dri.edu/>.

Redmond experiences high winds (with velocities of 50 mph) approximately once every two years. Winds that exceed 60 mph occur approximately once every 50 years. King County has reportedly experienced at least one serious windstorm per calendar year.

Previous Occurrences

The last significant windstorm to affect the City of Redmond occurred in 2006. In the Seattle region, hundreds of thousands of homes remained without power for several days after the storm. The lack of heat forced many residents to leave their homes and seek shelter in hotels or emergency facilities. The power outages closed many businesses, even Microsoft shut down large portions of its Redmond campus.²⁵

The last major winter storm was in December 2008, when the City received almost nine inches of snow in one day. The snow limited the ability of people and services to move around the City. Police officers had difficulty responding to calls in some neighborhoods. Garbage collection suspended service for 11 days. The Old Redmond Schoolhouse Community Center, Redmond Senior Center and Old Fire House Teen Center were closed Dec. 18-26, and City offices officially closed for two days.²⁶

Probability of Future Events

Reports from the International Panel on Climate Change and the University of Washington Climate Impact Group confirm that the region's climate is changing and that the impacts will be far reaching. The City of Redmond can expect an increase of severe storm events in the future.

While changes in overall annual precipitation are not projected to be significant, the timing and character of precipitation is projected to change. Winters will bring more rain and less snow in the mountains. Summers will generally tend to be dryer, increasing susceptibility to flash floods as a secondary hazard to severe summer rainstorms. In addition, the probability of secondary hazards will increase, including saturated soil hazards such as landslides and falling trees.

4.3 Assessing Severe Storm Vulnerability

4.3.1 Overview

Due to a typically mild climate, Redmond is vulnerable to severe storms. Ice, snow and strong winds can damage infrastructure, isolate citizens and limit access to essential services. Although storms may cause some structural damage, the main vulnerabilities to a severe storm are systems and populations that may not be able to withstand temporary isolation or limited transportation.

²⁵ Scott Sisteck, "The craziest year ever for weather?" Komo News, January 1, 2007, <http://www.komonews.com/news/local/5051876.html>.

²⁶ Mary Stevens Decker, "City looking to improve winter storm response plan," *The Redmond Reporter*, http://www.pnwlocalnews.com/east_king/red/news/37461739.html.

4.3.2 Profiling the Vulnerabilities

A. Man-made

The majority of the building stock in Redmond will be able to withstand the impacts of a snow, wind or ice storm. However, the vulnerability to such a storm varies by the location and the type of structure. Buildings located on hilltops are more vulnerable to lightning and those located on steep slopes are vulnerable to landslides. Flat-roofed buildings and other structures that accumulate snow may be susceptible to collapse under heavy snow.

B. Natural

Severe storms impact the natural environment by increasing stormwater runoff, as well as increasing flooding and tree displacement. Such alteration of the natural environment will impact fish and wildlife habitat. However, these are natural processes; absent prolonged climate changes, animals and their ecosystems are resilient to temporary changes in weather. However, severe storms may have an impact on species and habitats that are already stressed. For example, increased runoff could increase the saturation rate of soils, thus increasing the likelihood of downed trees in high wind. Sand on roadways to provide friction on icy surfaces may create sedimentation problems in local streams and rivers, thereby affecting salmon habitat.

The critical areas likely to be affected by severe storms are fish and wildlife habitat and wetlands. Redmond has more than ten different areas containing sizable wetlands.²⁷ At least 19 species of birds and six species of mammals are found within the wetlands in City of Redmond. See **Map 8, City of Redmond Wetlands** for the location of wetlands in Redmond.

Additionally, Redmond is home to endangered salmon. The Salmon Habitat Recovery Plan for Water Resource Inventory Area 8 recommends restoring floodplain connectivity and channel meander as well as riparian forest and large woody debris to the Sammamish River channel.²⁸ These aspects of the waterways in Redmond could all potentially be disrupted by severe storms.

C. Systems

Roads in Redmond are vulnerable to severe storms. Excess precipitation is likely to limit access and isolate citizens, but it is unlikely to cause major permanent damage to the transportation network. Heavy rain, ice or snow may make roads impassible or limit visibility to the extent that driving is not safe. Although the City does have a snow/ice removal plan, large residential sections of the City, particularly in the North Redmond and Education Hill neighborhoods, may not have vehicular access until the snow/ice melts. **Map 5, City of Redmond Motorized Transportation Network**, shows the road network in Redmond.

²⁷ SAO Wetland Wilderness Lookup Table, King County Dept. of Environmental Services, Paul McCombs, GIS Data Team Lead, KCGIS Center.

²⁸ WRIA 8 Coordination Team, Lake Washington/Cedar/Sammamish Watershed, "Final Lake Washington/Cedar/Sammamish Watershed (WRIA 8), Chinook Salmon Conservation Plan," <http://www.govlink.org/watersheds/8/planning/chinook-conservation-plan.aspx>, 2007.

Redmond has put most of the power lines underground; however, the remaining above-ground lines are vulnerable to high winds, ice and heavy snow. Additionally, heavy rainfall may loosen soils, making power poles and towers more susceptible to failure in high winds.

Water supply and sewer facilities may be vulnerable to severe storms with massive rainwater that quickly accumulates. Stormwater drains and culverts may overflow during a heavy rain event and cause flooding.

Power outages and limited accessibility may force businesses to temporarily shut down. These unexpected closures can result in large financial losses. Loss of power can cause large product losses for food service businesses. Since businesses operate within an inter-connected system, the closure of one may have large impacts on other businesses in the area. Smaller businesses may not be able to recover from the loss of business or damages caused by a severe storm.

Severe storms can leave residents completely isolated and without access to emergency assistance. Currently there are no hospitals in Redmond. Road closures may prevent residents that require significant medical care from access to necessities.

D. Populations

Isolated Populations

Residents of Redmond living on steep slopes, or areas accessed only by a steep slope are vulnerable to isolation during a heavy snow or ice event. Downed trees and power lines will further restrict mobility. People living in areas that are accessed only by one road may also become isolated in a severe storm. Each of Redmond's three hills may be isolated for several days.

Persons with Disabilities

Persons with disabilities may not be able to access vital services due to road closures. People with medical devices that require constant electricity are vulnerable to a power outage.

Children

Children may need to be reunited with parents, if road closures occur once they are separated (such as during the school day). **Map 7, City of Redmond Community Facilities**, shows the location of several types of community facilities, including schools. Children are likely to be concentrated in these areas if the events occur during a school day.

Elderly

Elderly people with compromised immune systems are particularly vulnerable to the cold if there is a power outage in the winter. Additionally, they may not be able to

access emergency medical facilities. People who rely on electricity for medical devices will be especially vulnerable. **Map 9, City of Redmond Concentration of People 65 Years or Older and Retirement Home Locations** shows the location of retirement homes; elderly housing facilities are highly concentrated within Redmond.

Limited English Language

Power outages may be particularly isolating to limited English language speakers, as non-English speakers face additional challenges when accessing emergency information. **See Map 10, City of Redmond People with Limited English Language Capability**, for the location of people that speak limited English.

Low-income Residents

According to an income analysis shown in **Map 11, City of Redmond Median Income by Block Group**, the majority of Redmond's low-income population is located on the edges of the City, furthest from services and resources. These residents may have limited transportation options and minimal financial capabilities in a severe storm. Absence from work due to isolation will be an additional burden for limited income households.

4.3.3 Analyzing Development Trends

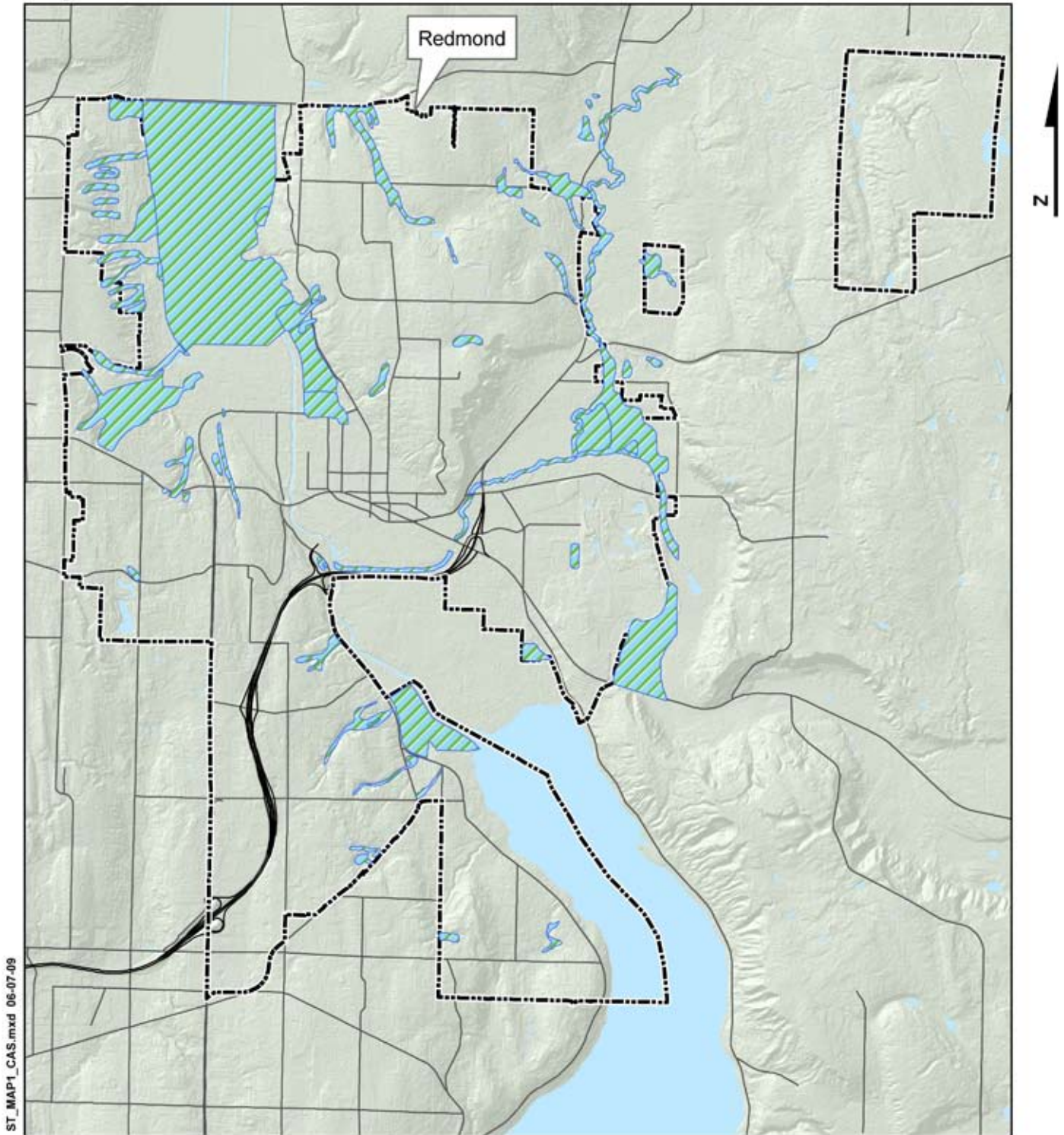
New residential expansion on the edges of town increases the number of people that are likely to become isolated during a severe storm. The lack of neighborhood-commercial land use in these neighborhoods show that there will be limited, if any, additional private capabilities to provide services during a storm. Small commercial facilities in residential areas could assist in distributing goods and services or they could simply provide a psychological break for isolated residents.

The Future Land Use Map (FLUM) shows that the City is concentrating growth in central areas such as Downtown and Overlake; this development will reduce the risk of isolation. Similarly, increased density will ensure better access to emergency facilities and resources.

4.4 Scenario

See Scenario 2 in the Part 3 Introduction.

City of Redmond Wetlands



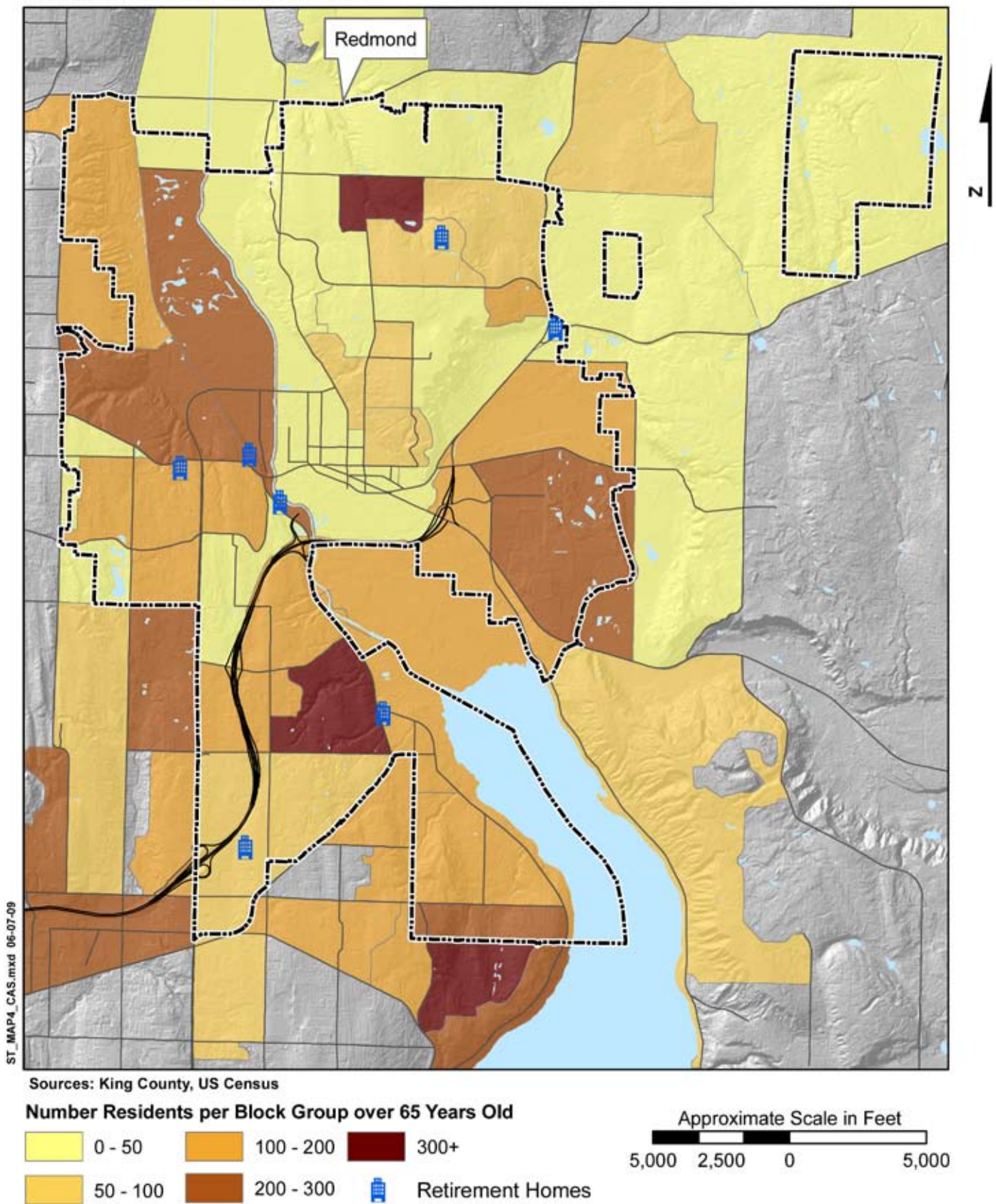
Sources: King County

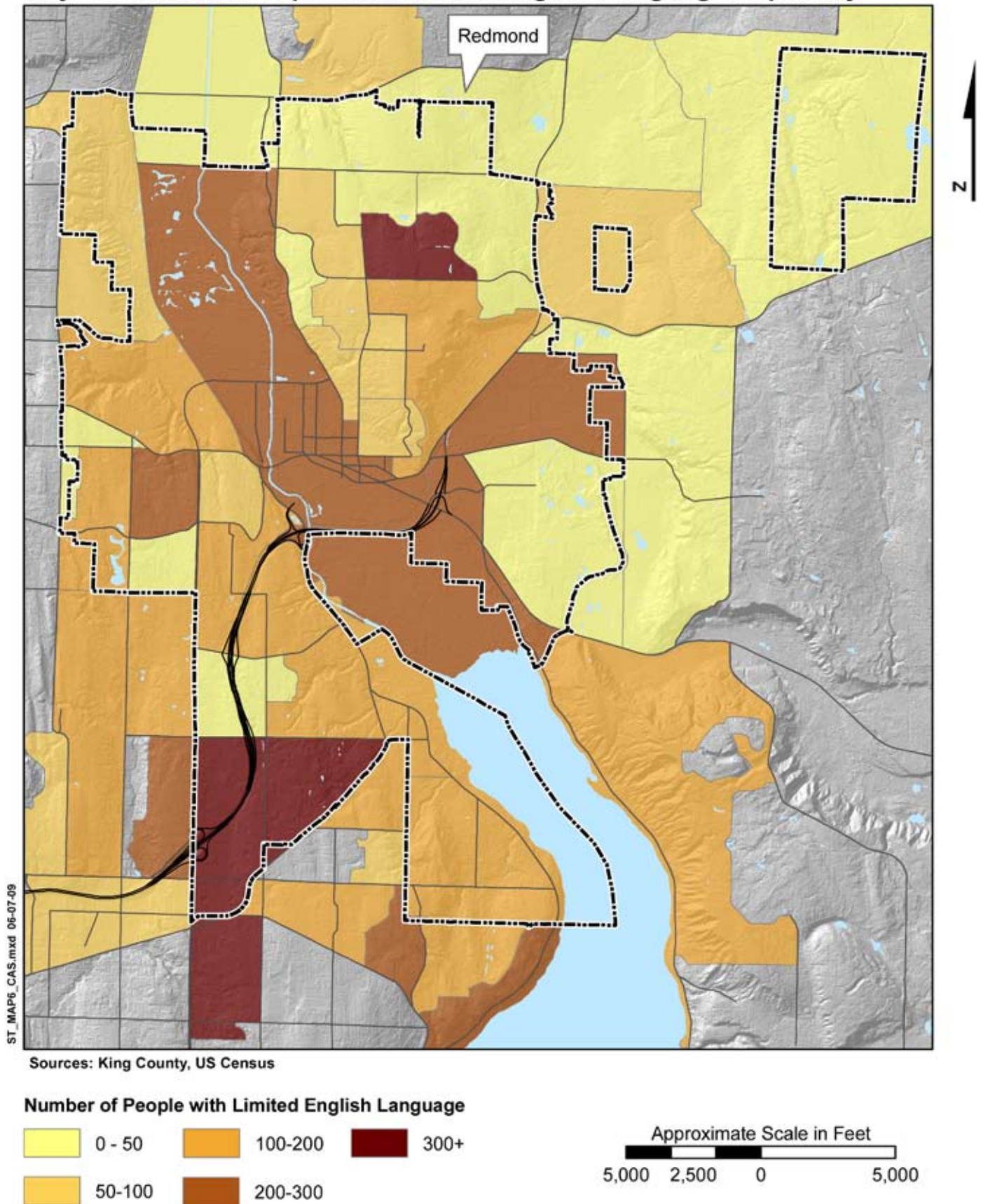
 Wetlands

Approximate Scale in Feet
5,000 2,500 0 5,000

Map 8: City of Redmond Wetlands

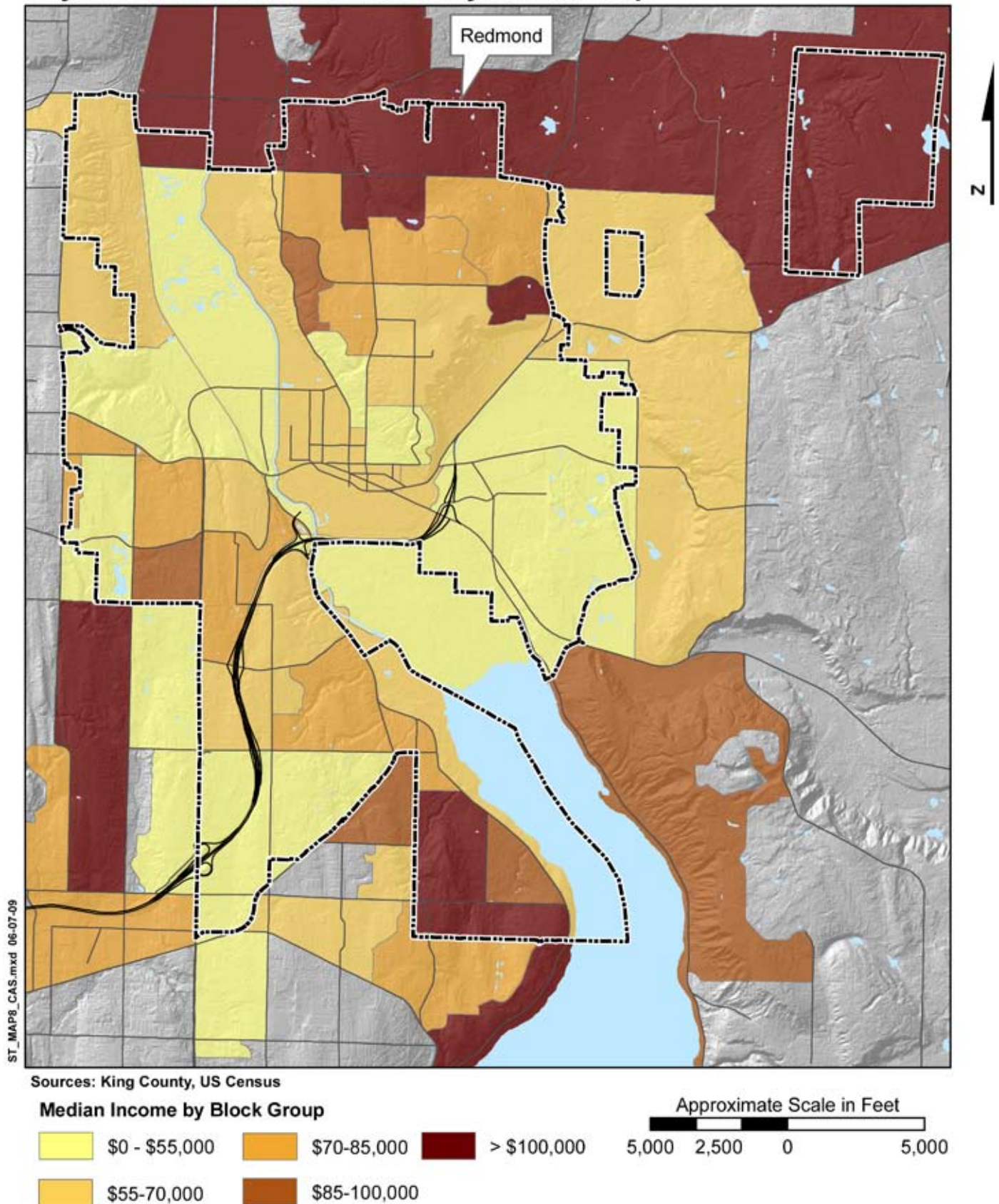
City of Redmond Concentration of People 65 Years or Older and Retirement Home Locations



City of Redmond People with Limited English Language Capability

Map 10: City of Redmond People with Limited English Language Capability
Hazard Identification and Risk Assessment

City of Redmond Median Income by Block Group



Earthquake Risk Assessment

This plan is an update of the 2004 City of Redmond Hazard Mitigation Plan (HMP). Although it is an update, this document has been redesigned so that it looks, feels, and reads differently than the original. This is due to several factors: new hazard information has become available that drives new definitions of risk, the City has matured and new capabilities are now available, and the new format will allow readers to more easily understand the content. In addition, the 2004 HMP included several action items that have been completed, creating an opportunity for developing new mitigation strategies.

5.1 Identify Earthquake Hazards

Earthquakes are vibrations caused by the movement of the Earth's crustal plates. The Earth's crust is, on average, approximately 45 miles thick and consists of several plates that slide over a partially molten layer of the planet.²⁹ The Pacific Northwest, including Redmond, is located in a subduction zone, characterized by oceanic plates sinking underneath continental plates.³⁰ In subduction zones, the crust builds up tension, which eventually releases with violent force. The resulting vibration causes distortion and uplift of the surface crust and may be extremely damaging.

The City of Redmond has a 0.2% chance that an earthquake with a peak horizontal acceleration of 0.25 G will occur in any given year (see **Map 13, City of Redmond Probabilistic Seismic Risk**).³¹ A G is the average acceleration produced by gravity at the earth's surface (9.80665 meters per second squared). This measurement describes ground shake during earthquakes.

The Puget Sound Region and Redmond are at risk of earthquakes from three sources:³²

- The Juan de Fuca plate is subducting underneath the North American plate.
- The Seattle Fault, located a few miles south of Redmond
- The South Whidbey Fault, located north of Redmond

Soil Liquefaction and Ground Shaking

Soil liquefaction and intense ground shaking often cause the most damage during an earthquake. Liquefaction occurs when strong earthquake shaking causes an immediate weakening of soils such that the soils take on properties similar to quicksand. Liquefaction most often occurs in artificial fill, and in highly saturated loose and sandy soils, such as low-lying coastal areas, lakeshores, and river valleys.

29 David Hyndman and Donald Hyndman, *Natural Hazards and Disasters 2006 Update* (Belmont, CA: Thomson Brooks/Cole, 2006).

30 Lynn S. Fichter, "Plate Tectonic Theory: Plate Boundaries and Interplate Relationships," James Madison University Department of Geology & Environmental Science.

31 Earthquake Hazards Program, "National Seismic Hazard Maps-2008," U.S. Geological Survey, <http://gldims.cr.usgs.gov/nshmp2008/viewer.htm>.

32 Michael A. Fisher et al., "Crustal Structure and Earthquake Hazards of the Subduction Zone in Southwestern British Columbia and Western Washington," U.S. Geological Survey, <http://pubs.usgs.gov/pp/pp1661c/pp1661c.pdf>.

Susceptibility to liquefaction is measured by the physical characteristics of a soil, such as grain, texture, compaction, and depth of groundwater.³³

Glacial till covers 60 to 70 percent of the City of Redmond, and is nearly impermeable due to its compact nature and scarcity of organic matter.³⁴ Deposited alluvium, found in Redmond, is made up of fine particles of silt and clay and larger particles of sand and gravel. According to the United States Geologic Survey (USGS), the seismic stability of alluvium is very poor, and the seismic stability of other post-glacial materials is very poor to fair.³⁵ The Sammamish River Valley that runs through Redmond is vulnerable to liquefaction during an earthquake.

Earthquake-induced ground shaking is strongest in river valleys and other soft-soil shorelines – conditions common throughout the City of Redmond (see **Map 14, City of Redmond Soil Liquefaction Hazard**). Ground shaking in soft soils layered on stiffer soils or rock is more severe than in areas with little variation between layers. The severity of soil-related natural hazards and ground failure phenomena often depends on status of groundwater, soil saturation, and drought conditions.³⁶ Soils prone to liquefaction and amplified ground shaking will present the most severe hazards.

Secondary Hazards

A significant earthquake in the Puget Sound Region is likely to cause any of the following secondary hazards:³⁷

- Liquefaction
- Landslides
- Tsunamis
- Seiche (a large displacement sloshing of water in a lake, such as Lake Sammamish, causing tsunami type damage)
- Building failure due to structure age and building construction
- Fires from downed power lines, gas or electrical equipment malfunctions
- Hazardous materials spills

A severe earthquake on the South Whidbey Fault may cause activity on other faults.³⁸

5.2 Profiling Earthquake Hazard Events

There are three types of earthquakes that occur within the Puget Sound Region:

33 Jorgen Johansson, "Soil Liquefaction Web Site," University of Washington Department of Civil Engineering, <http://www.ce.washington.edu/~liquefaction/html/main.html>.

34 Tracy Chollak and Paul Rosenfield, "Guidelines for Landscaping with Compost-Amended Soils," City of Redmond.

35 Mineral Information Service, "The Seattle Earthquake of April 29, 1965," California Geology 18, no. 7 (1965).

36 Jorgen Johansson, "Soil Liquefaction Web Site," University of Washington Department of Civil Engineering, <http://www.ce.washington.edu/~liquefaction/html/main.html>.

37 Cascadia Region Earthquake Workgroup, "Subduction Zone Earthquakes: A Magnitude 9.0 Earthquake Scenario, 2005," <http://www.crew.org/papers/CREWCascadiaFinal.pdf>.

38 Gale Fiege, "South Whidbey Fault Has Potential For Major Quake," The Daily Herald, June 15 2009, <http://www.heraldnet.com/article/20090615/NEWS01/706159921>.

subduction zone earthquakes, Benioff (deep) earthquakes, and crustal (shallow) earthquakes.³⁹ These types of earthquakes differ in location, timing and duration, severity, and frequency. Each type of earthquake is profiled individually.

Location of an earthquake is described by the focus and the epicenter. The focus is the first point of movement along the fault line. The epicenter is the corresponding point above the focus at the Earth's surface.

The severity of an earthquake depends on the intensity of surface shaking (peak ground acceleration) and potential damage to the built environment. Severity is commonly measured with the Modified Mercalli Scale or the Richter Scale (Table 12). The City of Redmond is at greatest risk of large, shallow, crustal earthquakes emanating from the Seattle or South Whidbey faults (see **Map 12, Regional Crustal Faults**).

5.2.1 Subduction Zone Earthquakes

A. Location

Subduction zone earthquakes are caused by the Juan de Fuca Plate sliding beneath the North American Plate. Currently, The Juan de Fuca Plate is sinking below the North American Plate at a rate of approximately 4.5 cm per year. This subduction zone is approximately 200 miles off the Washington coast.⁴⁰ This type of earthquake will affect the entire region, including Redmond.

B. Timing and Duration

Subduction zone earthquakes can happen at any time with shaking likely to last several minutes.⁴¹

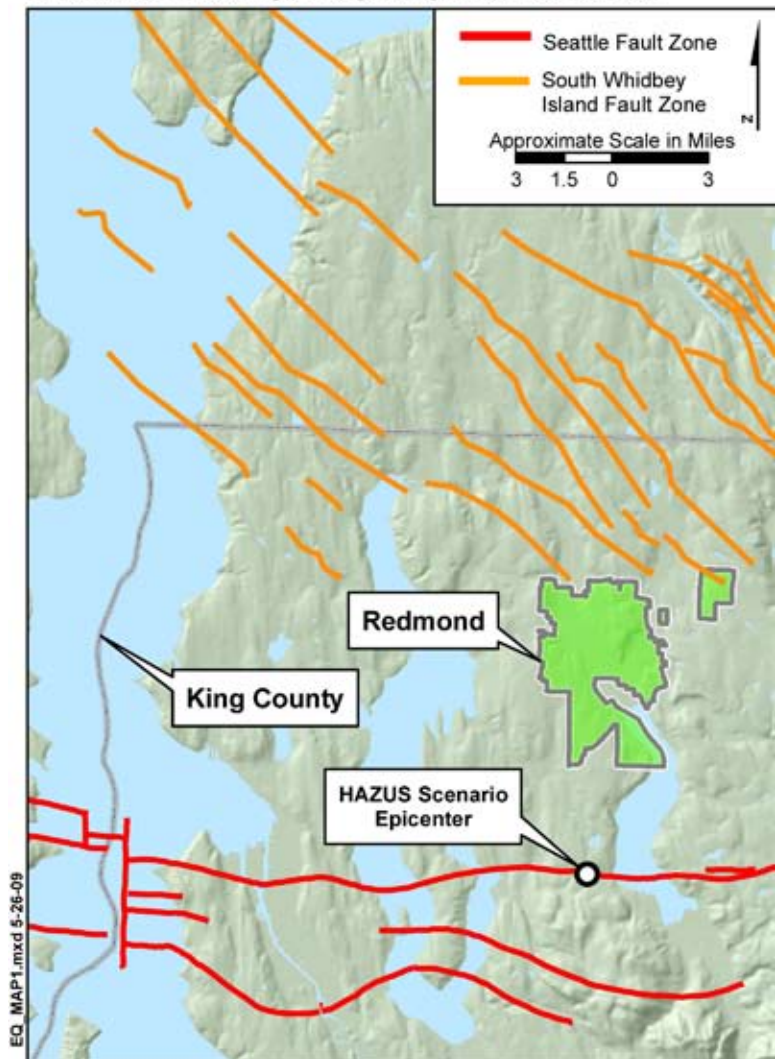
39 Ruth Ludwin, "Earthquake Hazards in Washington and Oregon," The Pacific Northwest Seismic Network, http://www.pnsn.org/INFO_GENERAL/eqhazards.html.

40 Michael A. Fisher et al., "Crustal Structure and Earthquake Hazards of the Subduction Zone in Southwestern British Columbia and Western Washington," U.S. Geological Survey, <http://pubs.usgs.gov/pp/pp1661c/pp1661c.pdf>.

41 Cascadia Region Earthquake Workgroup; Pacific Northwest Seismic Network Staff, "Earthquake Hazards in Washington and Oregon: Three Sources," The Pacific Northwest Seismic Network, <http://www.pnsn.org/CascadiaEQs.pdf>.

Regional Crustal Faults

Sources: State of Washington, King County, USGS, Sherrod 2008



Map 12: Regional Crustal Faults

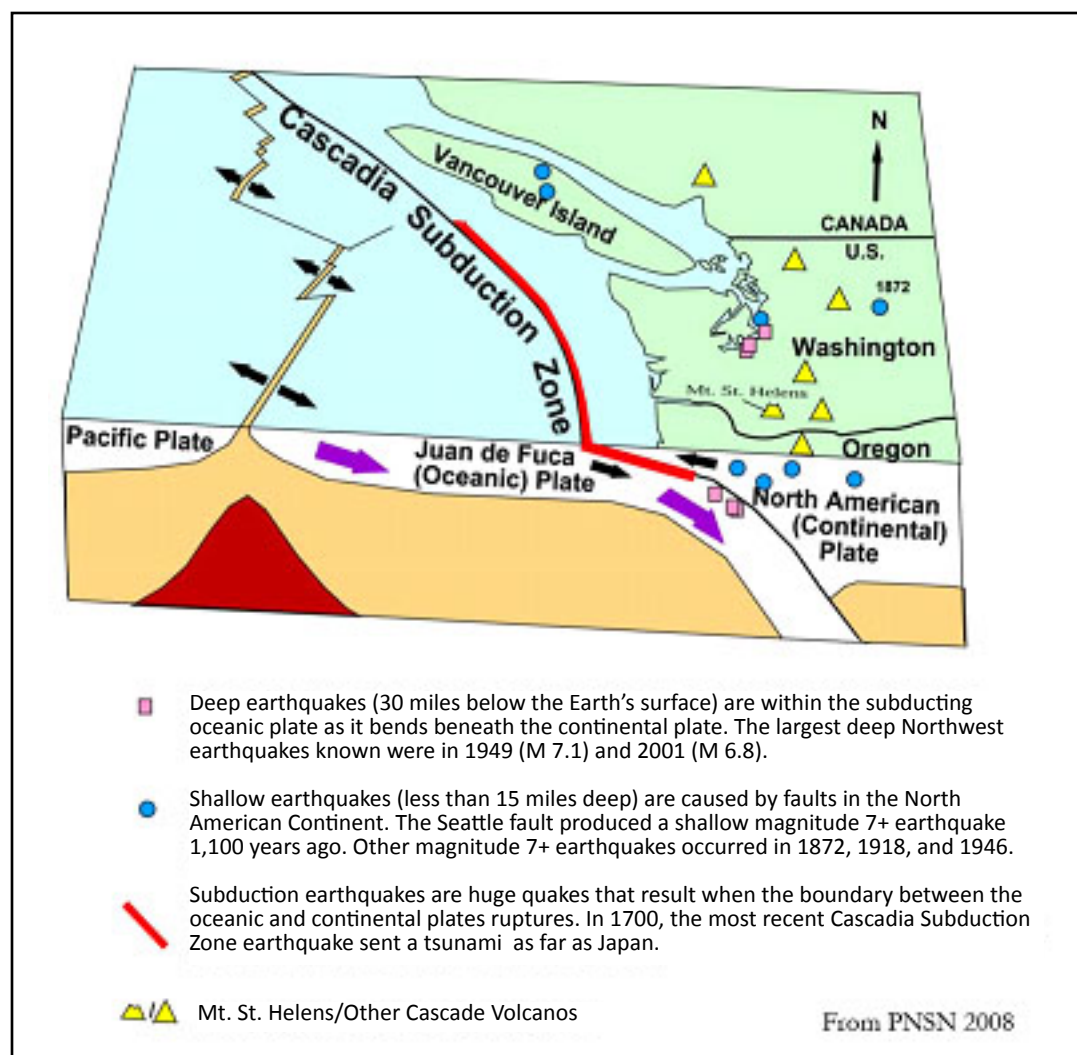


Figure 6: Earthquake Types in Washington

Source: Ruth Ludwin, Earthquake Hazards in Washington and Oregon: Three Source Zones.

C. Severity

Subduction zone earthquakes are extremely powerful, typically registering a magnitude of 8 to 9+ on the Richter scale.⁴² However, due to the location of the Juan de Fuca Plate, an earthquake of 8 or 9 magnitude would have a reduced local impact in Redmond. Such an earthquake would have similar shaking to the 2001 Nisqually earthquake (a magnitude 6.8, Benioff earthquake that lasted 2 minutes) but it would last much longer.

Subduction zone earthquakes cause longer shock waves than Benioff quakes and will be felt from a greater distance than the 2001 Nisqually earthquake.⁴³

42 Ray Flynn et al., "The Cascadia Subduction Zone – What is it? How big are the quakes? How often?" The Pacific Northwest Seismic Network, http://www.pnsn.org/HAZARDS/CASCADIA/cascadia_zone.html.

43 Cascadia Region Earthquake Workgroup, "Subduction Zone Earthquakes: A Magnitude 9.0 Earthquake Scenario, 2005," <http://www.crew.org/papers/CREWCascadiaFinal.pdf>.

The Modified Mercalli Scale	Level of Damage	The Richter Scale
1 - 4 Instrumental to Moderate	No damage.	4.3 or Below
5 - Rather Strong	Damage negligible. Small, unstable objects displaced or upset; some dishes and glassware broken.	4.4 - 4.8
6 - Strong	Damage slight. Windows, dishes, glassware broken. Furniture moved or overturned. Weak plaster and masonry cracked.	4.9 - 5.4
7 - Very Strong	Structure damage considerable, particularly to poorly built structures. Chimneys, monuments, towers, elevated tanks may fail. Frame houses moved. Trees damaged. Cracks in wet ground and steep slopes.	5.5 - 6.1
8 - Destructive	Structural damage severe; some will collapse. General damage to foundations. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground; liquefaction.	6.2 - 6.5
9 - Ruinous	Most masonry and frame structures/foundations destroyed. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Sand and mud shifting on beaches and flat land.	6.6 - 6.9
10 - Disastrous	Few or no masonry structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Rails bent. Widespread earth slumps and landslides.	7.0 - 7.3
11 - Very Disastrous	Few or no masonry structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Rails bent. Widespread earth slumps and landslides.	7.4 - 8.1
12 - Catastrophic	Damage nearly total. Large rock masses displaced. Lines of sight and level distorted.	Above 8.1

Table 12: Modified Mercalli Scale and Richter Scale

Source: FEMA for Kids, "The Disaster Area: Intensity Scales," Federal Emergency Management Agency, <http://www.fema.gov/kids/intense.htm>.

D. Frequency

The last large subduction zone earthquake to hit Washington State occurred on January 26, 1700 and had a magnitude of 9.0.⁴⁴ This type of earthquake occurs, on average, every 400 to 600 years.⁴⁵

5.2.2 Benioff (Deep) Earthquakes

A. Location

Benioff (deep) earthquakes in this region typically occur at a depth of approximately 15 to 60 miles below Western Washington. This occurs when the Juan de Fuca Plate slips against the North American Plate. This kind of earthquake would affect all of Redmond and the surrounding region.⁴⁶

⁴⁴ Ray Flynn et al., "The January, 1700 Cascadia Subduction Zone Earthquake and Tsunami," The Pacific Northwest Seismic Network, http://www.pnsn.org/HAZARDS/CASCADIA/cascadia_event.html.

⁴⁵ Cascadia Region Earthquake Workgroup; Pacific Northwest Seismic Network Staff, "Earthquake Hazards in Washington and Oregon: Three Sources," The Pacific Northwest Seismic Network, <http://www.pnsn.org/CascadiaEQs.pdf>.

⁴⁶ Ruth Ludwin, "Deep Quakes in Washington and Oregon," The Pacific Northwest Seismic Network, http://www.pnsn.org/HAZARDS/CASCADIA/cascadia_event.html.

B. Timing and Duration

Benioff earthquakes may happen at any time. Shaking will last a minute or less. Aftershocks are less commonly associated with Benioff earthquakes than with other types of earthquakes.⁴⁷

C. Severity

Benioff Zone earthquakes reach magnitudes of 7.5. These deep earthquakes can be high in magnitude, but the depth makes them less violent in terms of lateral acceleration than a similarly sized crustal (shallow) earthquake.

Compared to a subduction zone earthquake, the shaking from a Benioff earthquake will not be felt as far away and the shaking will not last as long. Due to the dip-slip character of Benioff earthquakes, large aftershocks are not common.⁴⁸ Benioff (deep) earthquakes are not the most severe of the types of earthquakes that affect Redmond.⁴⁹

D. Frequency

Benioff earthquakes occur most frequently in Redmond. This type of earthquake occurs roughly every 30 years.⁵⁰ There have been three major deep earthquakes in recent history: the 7.1 magnitude 1949 Olympia earthquake, the 6.5 magnitude 1965 Seattle-Tacoma earthquake, and the 6.8 magnitude 2001 Nisqually earthquake.⁵¹

5.2.3 Crustal (Shallow) Earthquakes**A. Location**

When the Juan de Fuca plate subducts beneath the North American plate, deformation of the crust causes crustal faults to form. Shallow earthquakes originate less than 15 miles below the surface of the earth.

The Seattle Fault and South Whidbey Fault (see **Map 12, Regional Crustal Faults**) are the two major crustal fault systems that can affect Redmond.⁵² The proximity of both of these faults to Redmond increases the potential damage. HAZUS⁵³ has been run for possible events that have epicenters within close proximity to Redmond.

www.pnsn.org/INFO_GENERAL/platecontours.html.

47 Cascadia Region Earthquake Workgroup; Pacific Northwest Seismic Network Staff, "Earthquake Hazards in Washington and Oregon: Three Sources," The Pacific Northwest Seismic Network, <http://www.pnsn.org/CascadiaEQs.pdf>.

48 Ruth Ludwin, "Deep Quakes in Washington and Oregon," The Pacific Northwest Seismic Network, http://www.pnsn.org/INFO_GENERAL/platecontours.html.

49 Cascadia Region Earthquake Workgroup, "Subduction Zone Earthquakes: A Magnitude 9.0 Earthquake Scenario, 2005," <http://www.crew.org/papers/CREWCascadiaFinal.pdf>.

50 Ibid.

51 Ruth Ludwin, "Deep Quakes in Washington and Oregon," The Pacific Northwest Seismic Network, http://www.pnsn.org/INFO_GENERAL/platecontours.html.

52 Michael A. Fisher et al., "Crustal Structure and Earthquake Hazards of the Subduction Zone in Southwestern British Columbia and Western Washington," U.S. Geological Survey, <http://pubs.usgs.gov/pp/pp1661c/pp1661c.pdf>.

53 HAZUS is FEMA's Methodology for Estimating Potential Losses from Disasters. HAZUS is a powerful risk assessment methodology for analyzing potential losses from floods, hurricane winds and earthquakes. In HAZUS, current scientific and engineering knowledge is coupled with the latest geographic information systems (GIS) technology to produce estimates of hazard-related damage before, or after, a disaster occurs. <http://www.fema.gov/plan/prevent/hazus/>.

B. Timing and Duration

Crustal earthquakes can happen at any time with shaking that lasts approximately 30 seconds. Crustal quakes have the shortest duration of the three types of earthquakes.⁵⁴

C. Severity

Of the three types of earthquakes, crustal earthquakes are currently thought to present the greatest risk to the Puget Sound region.⁵⁵ While they tend not to last as long as the other types of earthquakes, the short shock waves associated with them cause more violent ground shaking for the entire region than the other types of earthquakes.⁵⁶

D. Frequency

The largest known crustal earthquakes in the Puget Sound region took place in the years 900 and 1872. Each had magnitudes of approximately 7.4 on the Richter scale.⁵⁷ Recurrence intervals are unknown.

5.3 Assessing Earthquake Vulnerability**5.3.1 Overview**

Redmond's vulnerability to an earthquake is based on a variety of factors including its proximity to subduction zones and faults. Vulnerability of the built environment depends on the location, age, material, and condition of manmade structures. The natural environment's vulnerability reflects the existing condition and the characteristics of the event. The City's dependence on regional systems, the density of the population, and available resources impact Redmond's overall vulnerability to an earthquake.

The potential for severe earthquakes makes Redmond very vulnerable to the impacts. While the most intense damage will likely be confined to the liquefaction zone, the whole city and surrounding region will be affected at least marginally.

5.3.2 Profiling the Vulnerabilities**A. Man-made**

Table 13: Effect of Earthquakes on Different Types of Buildings represents how each of the different types of earthquakes will affect man-made structures.

54 Cascadia Region Earthquake Workgroup, "Subduction Zone Earthquakes: A Magnitude 9.0 Earthquake Scenario, 2005," <http://www.crew.org/papers/CREWCascadiaFinal.pdf>.

55 Ruth Ludwin, "Earthquake Hazards in Washington and Oregon," The Pacific Northwest Seismic Network, http://www.pnsn.org/INFO_GENERAL/eqhazards.html.

56 Cascadia Region Earthquake Workgroup; Pacific Northwest Seismic Network Staff, "Earthquake Hazards in Washington and Oregon: Three Sources," The Pacific Northwest Seismic Network, <http://www.pnsn.org/CascadiaEQs.pdf>.

57 Ruth Ludwin, "Shallow Crustal Quakes in Washington and Oregon," The Pacific Northwest Seismic Network, <http://www.pnsn.org/HAZARDS/SHALLOW/welcome.html>.

Earthquake Type	Skyscrapers	Mid-rise Structures	Wood Structures (under 5 stories)
Subduction Zone	May have structural damage or total collapse.	May have structural damage, but not as much as skyscrapers.	May have structural damage, but not as much as skyscrapers.
Benioff (Deep)	Structural damage is unlikely.	May have structural damage.	May have structural damage, but not as much as mid-rise structures.
Crustal (Shallow)	Structural damage is unlikely.	May have structural damage, but not as much as short, wood structures.	May have structural damage.

Table 13: Effect of Earthquakes on Different Types of Buildings

Developed areas in the soil liquefaction zone are particularly vulnerable to damage and structural failure. In any earthquake, older buildings or buildings that do not meet current codes are more vulnerable.

Approximately 7.5% of residential buildings (or 990 of the 13,386 residential buildings) and almost 49% of commercial and public buildings (or 1,968 of the 4,022 non-residential buildings) in Redmond are located in the low to high liquefaction areas (see **Map 15, City of Redmond Buildings Vulnerable to Soil Liquefaction**).

Developed areas are also vulnerable to secondary hazards of earthquakes such as landslides and fires. See corresponding hazards for specific information regarding vulnerability to secondary hazards.

B. Natural

The vulnerability to the natural environment primarily stems from secondary hazards such as liquefaction or other soil failure, landslides, seiche, fires, and hazardous materials spills. See information regarding specific hazard vulnerabilities for fires, landslides and hazardous materials spills in their appropriate sections.

C. Systems

The systems in Redmond are extremely vulnerable to an earthquake. Sewers, water pipes, culverts, electrical lines, roads and bridges may be severely damaged or fail during an earthquake.

An earthquake will cause a great deal of damage to the transportation systems in Redmond. The roads may be covered by debris or be affected by secondary hazards such as landslides or fires. The bridges are particularly vulnerable to collapse. Damage or collapse of the bridges over the Sammamish River or Bear Creek would isolate the Education Hill neighborhood. Damage or a collapse along SR 520 will isolate the entire City of Redmond.

Since there are no hospitals in Redmond and a large portion of first responders do not live within the city, medical and emergency response systems are vulnerable

to failures in the transportation system. If Redmond is cut off from other cities in the region, emergency responders will have difficulty getting to Redmond. During a regional event, hospitals are likely to be overwhelmed. If transportation networks fail, patients from Redmond may not have access to those facilities.

Goods and services may be limited, contributing to the vulnerability of businesses during an earthquake. Transportation failures and general chaos following an earthquake will complicate normal business operations. Consequently, isolated residents may have minimal access to goods and services that are usually provided by local businesses. Should businesses still be operable after an earthquake, the decrease in economic activity (from both suppliers and consumers) stemming from local or regional isolation may force some businesses to experience financial hardship.

Sanitation and water supply systems are vulnerable to damage or collapse from an earthquake, particularly if they are located in the liquefaction zones. Communication systems may be compromised as a result of downed electric and telephone lines, damage to cell phone towers, or overuse of the system immediately following an event. Compromised communication systems will make it difficult for people to report damage or call for assistance.

D. Populations

The impact of an event will affect different populations in different ways depending on capabilities of the population, available resources, and localized impacts.

Hazard Specific

People inside or near buildings that suffer structural damage during an earthquake may become injured or trapped. People in areas of higher density are more vulnerable to falling debris due to lack of open spaces to escape unsafe structures. People who live in liquefaction zones are more likely to be in need of emergency shelter after an event. Water supply infrastructure is extremely vulnerable to damage during an earthquake, particularly the City wells that are located in a liquefaction zone. All residents living east of Sammamish River and Lake, who rely on well water, are more vulnerable to a subsequent hazardous materials spill or sewer breakage because the water supply may become contaminated (see **Map 20, City of Redmond Water Supply and Sewer Infrastructure**).

Isolated Populations

Road blockage or damage may cause local neighborhoods to become isolated. Isolation will decrease the availability of emergency services and access to vital necessities like food and water. Residents in Education Hill, Overlake and Downtown may be isolated in the days following a major earthquake.

In the event of a major regional earthquake, the entire City may become isolated from the rest of the Puget Sound Region. According to the Washington State Department of Transportation (WSDOT), the floating bridge on SR 520 will likely collapse in the

event of a major earthquake.⁵⁸ People in Redmond may be isolated due to the large number of City employees that reside outside the City and the lack of resources, supplies, and increased difficulty to reach medical facilities.

Disabled Persons

Disabled persons are more vulnerable in an earthquake than people who are not disabled because they cannot respond to the event as quickly. Moving out of the way of falling debris or navigating obstacles may be more difficult for a disabled person. This may hinder their ability to get to a safe area or get help.

Children

An earthquake during school hours may separate children from their families. Children may have limited transportation options when attempting to reunite with their parents.

Elderly

Decreased agility makes elderly people more vulnerable to an earthquake. Elderly with compromised immune systems or other health needs may experience delayed emergency services or limited access to prescriptions. People with limited mobility or transportation options are more likely to become isolated in their homes. Those that rely on electrically powered medical devices are particularly vulnerable to power outages.

Limited English Language

Language barriers may inhibit individuals from getting help from emergency services or limit their access to critical information. During work and school hours, it is more likely that people with limited proficiency will be isolated.

Low-income Residents

People with limited financial resources may not be able to pay for immediate emergency services. Should employment centers close as a result of an earthquake, these unexpected days without work may impose a significant financial hardship. Costly mitigation and preparation strategies, like attaching homes to their foundations, may also be difficult for low-income residents. Limited mitigation and insufficient emergency funds make low-income residents vulnerable.

5.3.3 Analyzing Development Trends

Currently, approximately 7.5% of residential buildings and almost 49% of non-residential buildings (commercial and public) in Redmond are located in the liquefaction zone. The City's Future Land Use Map (FLUM) indicates there will be increased density in Downtown. Much of the liquefaction area is zoned for mixed use that will include various combinations of multi-family housing, single-family homes, businesses, manufacturing, urban recreation, parks and open space. For information

58 "WSDOT Projects: SR 520 Program - Safety and Vulnerability." <http://www.wsdot.wa.gov/Projects/SR520Bridge/vulnerability.htm>

on how development trends are pertinent to secondary hazards, such as landslides and fires, refer to the corresponding sections.

5.4 Scenarios

A. Subduction Zone Earthquake

On September 5th, at 11:35 a.m., a large subduction zone earthquake shook the whole Puget Sound region for nearly ten minutes. It reached 8.1 on the Richter Scale. A metal gas line broke during the earthquake and sparked a fire at the north edge of the City. Since it has not rained in three weeks, four fires began in the immediate aftermath of the earthquake. Due to regional destruction, the Redmond Fire Department is unable to get additional assistance from neighboring communities.

Several high-rise buildings in Seattle and Bellevue completely collapsed in the earthquake. Two days after the shaking, emergency responders are still working to rescue people from the rubble. There are ten reported deaths and over thirty people remain missing.

Most of Redmond's mid-rise and wood-frame buildings are still intact, although there was some damage to the buildings in the downtown area that have brick and stone facades. Some older homes with brick chimneys also experienced damage. Due to transportation network failures, schools remained open until 8 p.m. until all children could be reunited with their families. SR 520 was closed for thirty-six hours until all overpasses were determined to be safe.

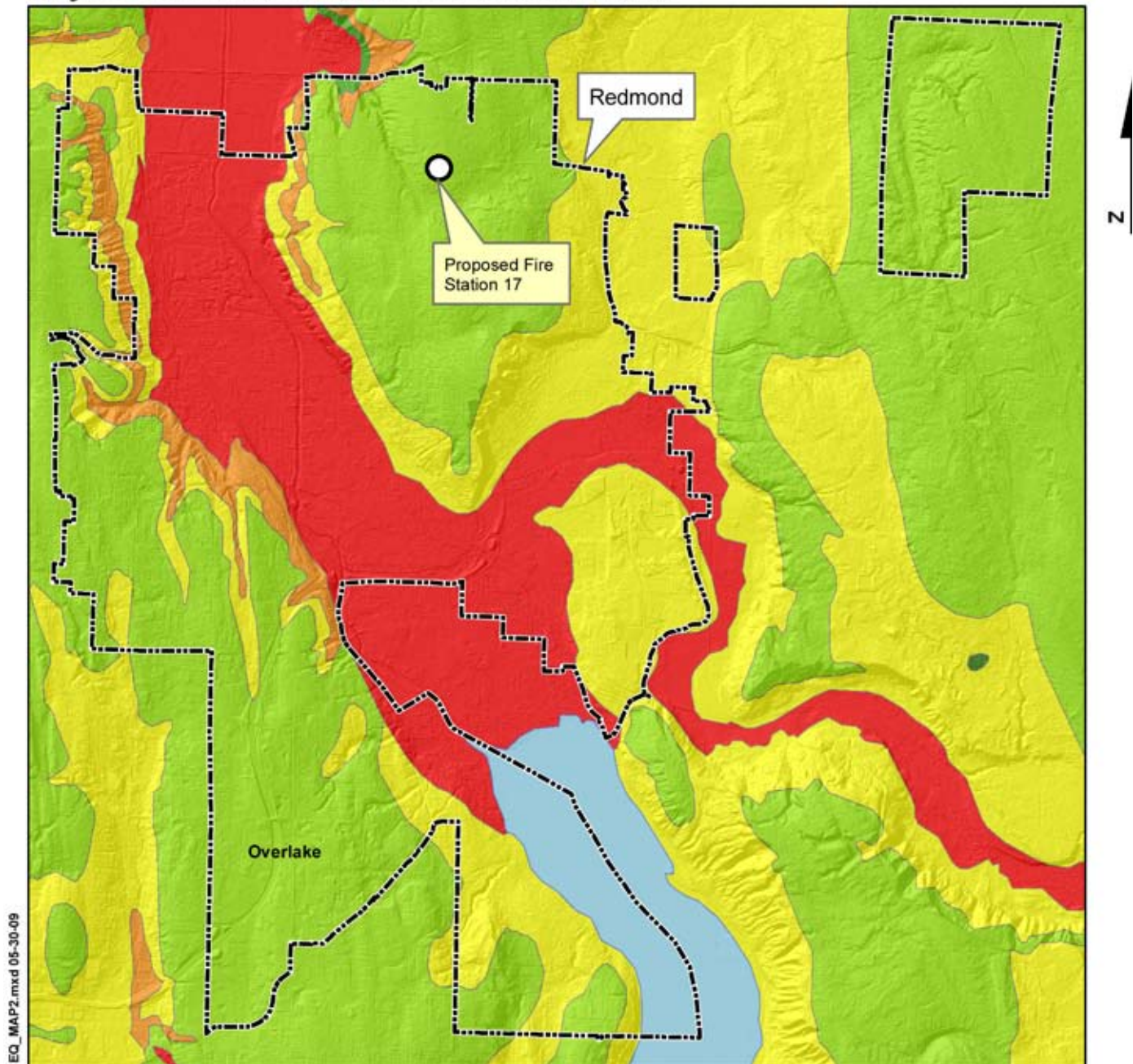
B. Benioff (Deep) Earthquake

On April 15th, at 9:20 a.m., a deep, Benioff earthquake shook the ground for one and a half minutes. In Redmond, there was some soil liquefaction, but it has been minimal and similar to effects from the 2001 Nisqually earthquake. There is little damage to the structures in the City, most of which affect the older downtown buildings with unreinforced masonry. The falling debris downtown injured two people, no deaths were reported. It rained for five days before the earthquake, the ground was fairly saturated. No major landslides have occurred, but some people have noticed some slight shifting on some hillsides. Most of the region has not experienced very much damage thus far, so connections remain stable and Redmond remains resilient.

C. Crustal (shallow) Earthquake

See Part 3, Scenario 1. Appendix C shows the global report from HAZUS for a 6.7 magnitude earthquake on the Seattle Fault.

City of Redmond Probabilistic Seismic Risk



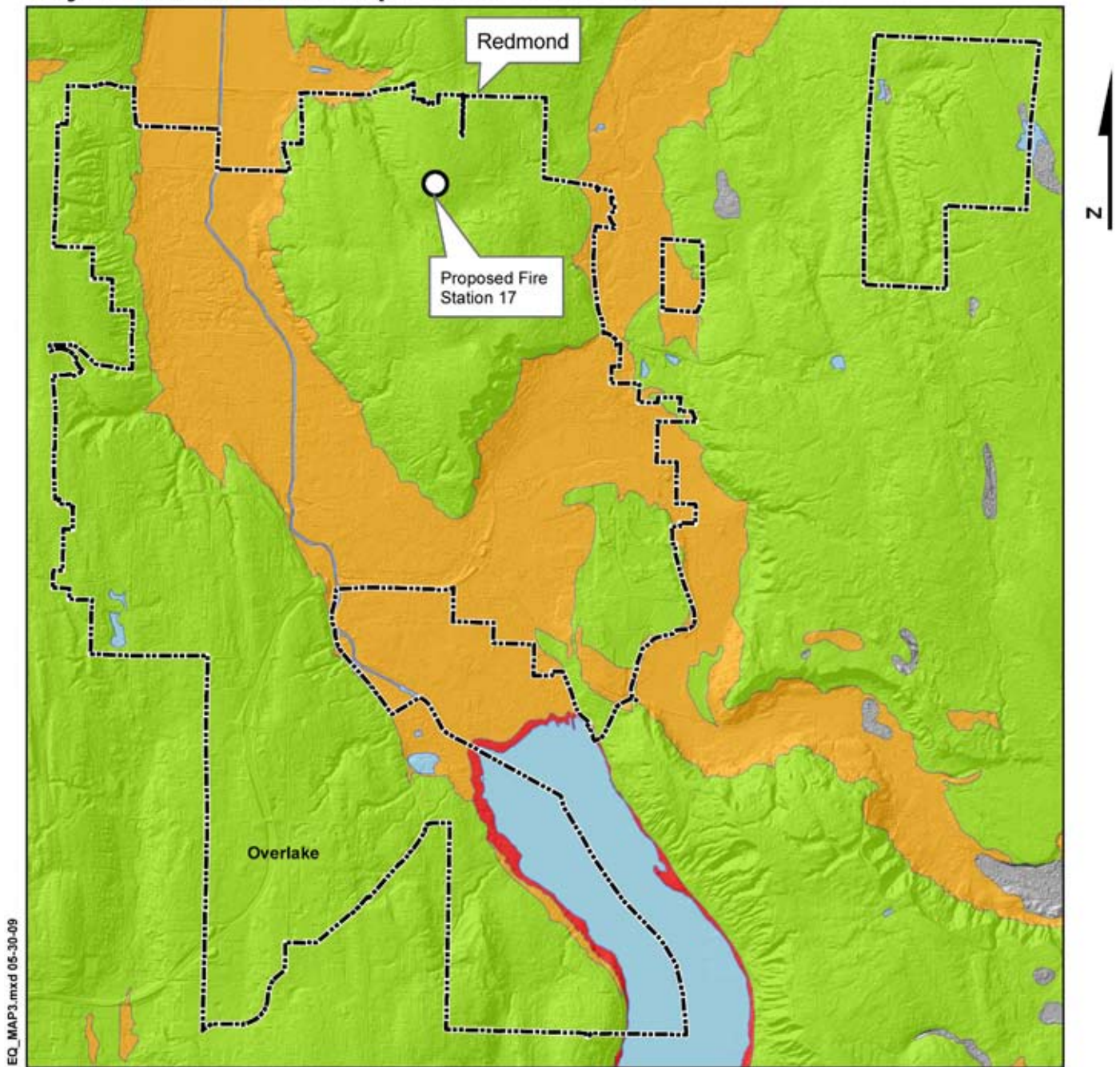
Sources: State of Washington, King County, NEHRP, and USGS.

NEHRP Soil Class and Peak Horizontal Ground Acceleration (in %G)

■ E-D	■ C 30%	■ water
■ D 32.5%	■ B-C	
■ C-D	■ B 25%	

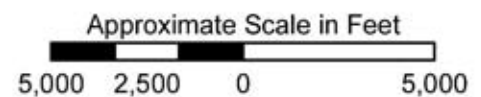
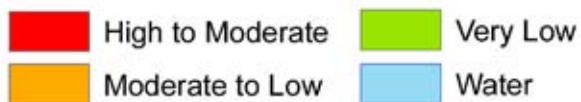
Note: 10% Probability of Exceedance in 50 Years (0.2% per Year)

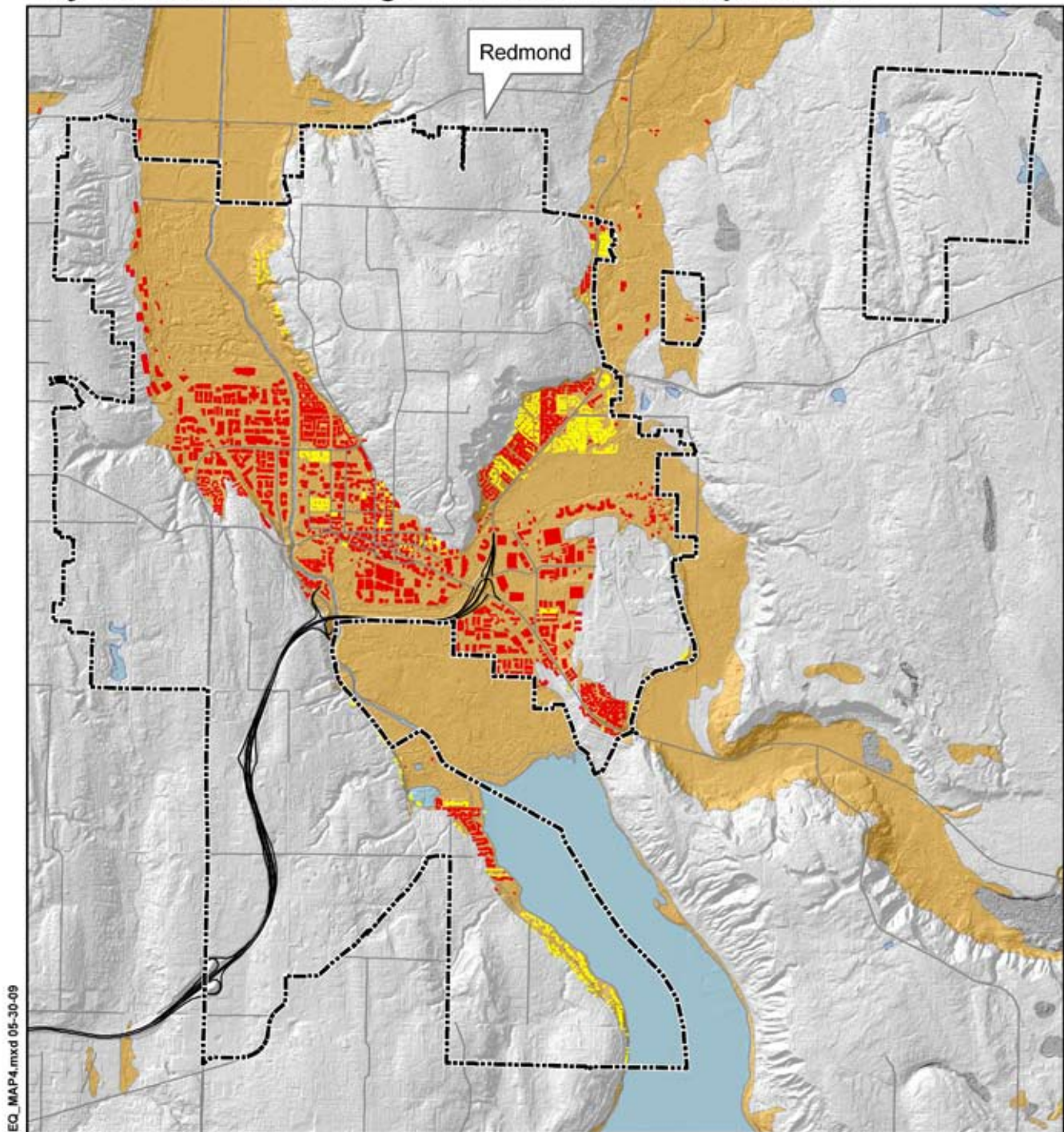
City of Redmond Soil Liquefaction Potential



Sources: State of Washington, King County, NEHRP, and USGS.

National Earthquake Hazard Reduction Program (NEHRP) Soil Liquefaction Potential



City of Redmond Buildings Vulnerable to Soil Liquefaction

Sources: State of Washington, King County, NEHRP, and USGS.

- Residential Buildings
- Commercial Buildings
- Liquefaction Hazard Area

Approximate Scale in Feet

5,000 2,500 0 5,000

Floods Risk Assessment

This plan is an update of the 2004 City of Redmond Hazard Mitigation Plan (HMP). Although it is an update, this document has been redesigned so that it looks, feels, and reads differently than the original. This is due to several factors: new hazard information has become available that drives new definitions of risk, the City has matured and new capabilities are now available, and the new format will allow readers to more easily understand the content. In addition, the 2004 HMP included several action items that have been completed, creating an opportunity for developing new mitigation strategies.

6.1 Identify Flood Hazards

A flood is a temporary inundation with water of normally dry land⁵⁹. Flooding can be caused by a body of water such as a river overflowing its banks or by a rapid accumulation of surface-water runoff.⁶⁰ Built structures can become flooded by groundwater seepage when the water table rises or the surrounding ground becomes saturated.

Flood damage can range from minimal localized damage to complete destruction of built structures. The velocity and volume of water present a risk in a flood event. Additionally, contaminants in the water pose a secondary threat.⁶¹ Flood water may contain gasoline or other hazardous chemicals as well as debris. Consequently, flooding can present both immediate concerns and secondary effects.

FEMA requires municipalities to plan for the 100-year flood. The 100-year floodplain is an area that has a 1% chance of flooding in any given year.⁶²

Climate Change Impact

Research conducted by the International Panel on Climate Change suggests that within any given future year, wetter winters with increasing rainfall and rain intensity can be expected.⁶³ In Redmond, this will lead to a higher frequency of flood events as well as the potential raising of the water level. Anticipated climate changes suggest that Redmond will experience more flooding from groundwater seepage and more frequent flooding along the Bear Creek and Sammamish River trails and Lake Sammamish.

59 Janet Thingpen, *Stream Processes: A Guide to Living in Harmony with Streams* (New York: Chemung County Soil and Water Conservation District, 2006), 68.

60 National Flood Insurance Program, "Flooding and Risks: What Causes Flooding," Federal Emergency Management Agency, http://www.floodsmart.gov/floodsmart/pages/flooding_flood_risk/what_causes_flooding.jsp.

61 Federal Emergency Management Agency and American Red Cross, *Repairing Your Flooded Home*, (Washington DC: FEMA Publications, 1992), 15.

62 Susan Bolton, JL Clark, Bob Freitag, and Frank Westurland, *Getting Wet: Benefiting from Flooding in the 21st Century*, (Draft, 2009), 9.

63 Climate Impacts Group: Joint Institute for the Study of the Atmosphere and Ocean, "Seasonal to Interannual Forecasts; Extreme Weather: Background," University of Washington, <http://cses.washington.edu/cig/fpt/exbackground.shtml>.

6.2 Profiling Flood Hazard Events

A. Location

The Sammamish River, Bear Creek, Evans Creek, and parts of Lake Sammamish are located within the City limits of Redmond. A large portion of Redmond's downtown district lies within the 100-year Sammamish River floodplain. **Map 16, City of Redmond 100-Year Floodplain and Chronically Flooded Areas**, shows the location of the floodplain and the waterways. Swelling or over-topping of the Lake Sammamish will flood lakeside homes and docks. The high water table, with an estimated average depth of 25 feet, increases the likelihood of seepage flooding.

Areas regularly flooded include parts of the Sammamish River and Bear Creek trail systems, portions of the City's Municipal Campus, condominium developments along Lake Sammamish, and an area near Bear Creek's Friendly Village Mobile Home Park. **Map 16, City of Redmond 100-Year Floodplain and Chronically Flooded Areas**, illustrates areas of chronic flooding in Redmond and identifies flood-related capital improvement projects (CIPs).

The majority of structural flooding in Redmond occurs in buildings with crawl spaces, basements, subsurface parking or other underground development. The swelling of the Sammamish River causes the water table to rise, which then seeps into underground spaces. In January 2009, the Lake Sammamish condominium owners and the Friendly Village mobile home owners used sandbags to block water from entering their structures.

The City of Redmond is a member of the National Flood Insurance Program. Residents living in the 100-year floodplain are required to have flood insurance. There have only been five claims within Redmond's City limits through FEMA's National Flood Insurance Program (NFIP). The locations of the claims are shown in **Map 17, City of Redmond NFIP Claims and Holders**. Only one of the five claims lies within the 100-year floodplain. The remaining claims were the result of groundwater seepage or drainage problems.

B. Timing and Duration

Weather forecasts and the close monitoring of local water systems normally provide substantial warning prior to flooding. 50% of Redmond's annual precipitation typically occurs in the four-month period from October through January and 75% occurs in the six-month period from October through March.⁶⁴ Flash floods or floods caused by a collapse of land along a shoreline have a significantly shorter warning time.

Groundwater seepage and stormwater runoff cause most of the flooding in Redmond. Since the wet season is the typical time for these issues, the City usually has adequate time to prepare. Also, much of the City is far enough away from the Sammamish

⁶⁴ King County Department of Natural Resources and Parks, Water and Land Resources Division, "2006 King County Flood Hazard Management Plan," King County River and Floodplain Management Program.

River that groundwater level may take up to six hours⁶⁵ to rise in response to a Sammamish River flood event. Knowledge gained from past occurrences can also help localized areas of flooding prepare for future events.

The duration of a flooding event may be limited to a few hours or may extend for several days or even weeks.

C. Severity

Though frequent, flood events in Redmond are not particularly severe. According to the FEMA 100-year flood depth grids, the majority of the floodplain will become inundated by only one foot of water. Two small portions of the floodplain near the convergence of Bear Creek and the Sammamish River are susceptible to inundation between two and three feet (see **Map 18, City of Redmond Buildings Vulnerable to Flooding**). Since the 100-year floodplain is large, deep floodwaters are not a concern. Flood damage costs in Redmond are typically low compared to other King County municipalities.

Although flooding in Redmond tends to be shallow, water on roadways may cause significant road damage and limit access to important transportation routes or other services. While it is important to note that Redmond is not susceptible to large-scale severe flooding, any amount of water on a roadway in Redmond will create significant problems for the City, its residents, and those that are employed within its boundaries.

Redmond's building codes are based on a 100-year Sammamish River flood with a flow rate of 1,920 CFS (cubic feet per second). The resulting codes are stricter than the FEMA requirement, which is based on a 100-year Sammamish River flood flow rate of 1,535 CFS.⁶⁶ The building codes, in coordination with a well-monitored permitting process, regulate construction in the floodplain. Homeowners with frequently flooded crawl spaces or basements are prepared with water pumps to reduce water damages to their homes.

Should stormwater drains become clogged and overflow into a permeable surface area (such as low impact development practices like permeable pavement, rain gardens, or infiltration trenches; or lawns and other landscaped areas), there is risk of groundwater contamination. Within the City's drinking water wellhead protection zones, this risk has the potential consequence of requiring a very expensive cleanup or loss of up to 40% of the City's drinking water resource. The presence of hazardous materials within flooded areas increases the potential risk to the groundwater during flood events.

D. Frequency

Past Occurrences

In Redmond, the areas along the Bear Creek and Sammamish River trails flood more

⁶⁵ Bob Franklin, City of Redmond Floodplain Manager, informational interview, April 16, 2009.

⁶⁶ Bob Franklin, City of Redmond Floodplain Manager, informational interview, April 16, 2009.

frequently than other areas of the City. The United States Army Corps of Engineers' flood control project in the 1960s altered the natural path of Bear Creek and the Sammamish River to reduce flood frequency and severity in Redmond. In recent years, the City has experienced minor flooding almost annually. While such flooding may occur once or twice a winter season, groundwater seepage and stormwater drainage can be a consistent problem in rainy months. **Table 14, Past Occurrences of Flooding in Redmond**, provides specific information about the location and extent of historical flooding.

Past Occurrences of Flooding in Redmond			
Date	Location	Type	Extent
1/18/1986	Bear Creek	Riverine	Roadways over-topped, mobile home park flooded and evacuated
1/3/1997	Sammamish River	Riverine	Over-topping of pedestrian trail near NE 124th St.
1/2006	Bear Creek	Riverine	Reached capacity but did not over-top. Debris collected at bridges that crossed the creek's span.
12/2007	Sammamish River	Riverine	Over-bank inundation of river near NE 85th St, drainage system and storm water flooding at 150th Ave NE and in Overlake area
Chronic	Education Hill	Drainage	Localized flooding of small neighborhood
Chronic	82nd St between 169th Ave NE and 170th Ave NE	Drainage	Roadways within 1-block radius inundated
Chronic	Union Hil Rd. between 185th Ave NE and 196th Ave NE	Drainage	Nuisance flooding of existing street and parking areas of local businesses
Chronic	NE 40th St and Bel-Red road	Drainage	Localized nuisance flooding in intersection
Chronic	3060 and 3068 W Lk Sammamish Pkwy	Drainage	Nuisance ponding
Chronic	4850 162nd Ave NE, Marymoor Hills	Drainage and Seepage	Localized flooding; flooding of crawlspaces
Chronic	Willows Business Park 152nd	Drainage	Frequent nuisance flooding
Chronic	8350 164th Ave NE, 8450 165th Ave	Drainage	Frequent flooding of parking lot
Chronic	Willows Business Park 92nd St	Stream/Riverine/Drainage	Nuisance flooding
Chronic	14001 NE 72nd St	Drainage	Localized flooding
Chronic	15000 NE 95th St	Drainage	Frequent nuisance flooding of parking lots
Chronic	156th Ave NE and NE 56th Way	Drainage	Ponding, Damage to paved surfaces
Chronic	162nd Ave NE and NE 57th St	Drainage	Ponding, Damage to paved surfaces
Chronic	140th Ave and NE 70th St	Drainage	Ponding, Damage to paved surfaces
Chronic	156th Ave NE and NE 65th Way	Drainage	Ponding, Damage to paved surfaces
Chronic	NW corner of Marymoor Park, South of 18000 NE 65th St	Drainage	Blocked access to loading docks and building entrances

(Table 14 continued on next page)

Past Occurrences of Flooding in Redmond (continued)			
Date	Location	Type	Extent
Chronic	2812 183rd Ave NE	Seepage	Groundwater flows year-round across sidewalk
Chronic	NE 48th St Conveyance	Drainage and Seepage	Capacity issues with groundwater under roadway
Chronic	Willows View Apartments	Drainage and Seepage	Water on sidewalks; damaged rockery
Chronic	17750 NE 21st St	Drainage	Damaged rockery
Chronic	176th Ave NE and NE 70th St	Drainage	Ponding, water over roadway
Chronic	S side of NE 24th, west of 179th Ave NE	Drainage	Blockage of culverts
Chronic	2000 West Lake Sammamish Pkwy	Drainage	Ponding on roadway
Chronic	9216 162nd Pl NE	Drainage	Flooding behind residential home
Chronic	Eastside of 146th just south of Old Redmond Rd	Drainage	Flooding of street; in 1993 flooding of homes
Chronic	177th Ave NE; Argyle Division	Drainage and Seepage	Surface erosion and flooding from pipe seepage
Chronic	City of Redmond Public Safety Building	Seepage	Flooding of below-ground parking garage
Chronic	Marriot Hotel	Seepage	Flooding of below-ground parking garage
Chronic	Sammamish River Trail and Bear Creek Trail	Riverine	Inundation of paved pedestrian trails making them impassable.

Table 14: Past Occurrences of Flooding in Redmond

Sources: City of Redmond Department of Natural Resources, "Stormwater Capital Improvement Program and City of Redmond," City of Redmond, <http://www.redmond.gov/insidecityhall/publicworks/stormwater/cipstormwater.asp> and City of Redmond Department of Natural Resources, "2009 Comprehensive Flood Hazard Management Plan".

Probability of Future Events

With climate change, more development in the watershed, increased stormwater runoff, and the introduction of more impermeable surfaces, the frequency of localized flooding events is likely to increase. Climate change research suggests an increase of extreme weather patterns with wetter winters characterized by increased precipitation and intensity.⁶⁷ The projected changes will increase the occurrence and severity of flooding events in Redmond.

6.3 Assessing Flood Vulnerabilities

6.3.1 Overview

Three large bodies of water coupled with a high water table pose a risk of flooding in Redmond. The presence of valuable buildings, infrastructure, natural environment and people make the City vulnerable to riverine and seepage flooding. Irregular weather and precipitation patterns resulting from climate change will also increase the City's vulnerability to floods.

⁶⁷ Climate Impacts Group: Joint Institute for the Study of the Atmosphere and Ocean, "Seasonal to Interannual Forecasts; Extreme Weather: Background," University of Washington, <http://cses.washington.edu/cig/fpt/exbackground.shtml>.

6.3.2 Profiling the Vulnerabilities

A. Man-made

Though riverine floods have been relatively mild in Redmond, flooding does cause damage to the built environment. **Map 18, City of Redmond Buildings Vulnerable to Flooding**, shows the flood depths and buildings located within the 100-year floodplain. There are 166 buildings located within the 100-year floodplain. Of these, 116 are single-family and 50 are multi-family units.⁶⁸ The mean appraised value of the buildings is \$2.1 million.⁶⁹ The City of Redmond does not have any repetitive loss structures.

Map 17, City of Redmond NFIP Claims and Holders, shows the buildings in the floodplain, NFIP holders and properties that have filed flood insurance claims. The claims range from \$0 to \$11,199 and average approximately \$2,600. Four of the five flood insurance claims have been related to seepage flooding outside of the floodplain.

Lakeside homes and docks are vulnerable to swelling or overtopping of the lake. As shown in **Map 18, City of Redmond Buildings Vulnerable to Flooding**, there are many lakeside homes within the floodplain.

B. Natural

The most significant threat posed by floods to the natural environment is the potential damage to fish and wildlife habitat. Channel alteration may affect wetlands and habitats in frequently flooded areas. A 25 to 50-year flood event in Bear Creek may result in significant damages to delicate riparian vegetation. The runoff associated with development and increased impervious surfaces has increased the occurrence of flooding. Runoff, bank erosion, sedimentation and siltation can alter the aquatic ecosystem and be potentially devastating to the fish habitat. While building in a floodplain may damage ecosystems, a flood induced by encroachment on the floodplain may further this damage by introducing toxins, debris, and significant amounts of sediment to the system. The flood's flow velocity may further increase losses to the ecosystem by removing riparian vegetation and salmon spawning areas.

Critical areas likely to be affected by flooding, including fish and wildlife habitat and wetlands, are shown in **Map 19, City of Redmond Natural Environment Vulnerable to Flooding**. Although these areas experience natural flooding, further development and climate change impacts may cause regular flooding events to have a greater impact on the natural environment. In addition to the Endangered Species Act's (ESA) designation of the Puget Sound Chinook salmon and bull trout as endangered species, Redmond is working hard to restore habitat in and near streams that will benefit species that have been listed, and other species, too.

⁶⁸ City of Redmond Department of GIS Services. 1999. RedmondGIS.DBO. Building GIS data layer.

⁶⁹ King County. Department of Assessments. Real Property Account. Assessor's <http://www.metrokc.gov/Assessor/download/download.asp>

C. Systems

Transportation, water systems, sewer systems and businesses located in the 100-year floodplain are vulnerable to flooding.

Sewer, stormwater and underground well water infrastructure are vulnerable to both riverine and stormwater and seepage floods. Since 40% of Redmond's water supply is provided by public wells, contamination of the wells would limit the availability of clean, fresh water in the City. Contamination of the groundwater would be difficult, if not impossible, to reverse. **Map 20, City of Redmond Water Supply and Sewer Infrastructure**, shows the location of sewer and water facilities that are located in the floodplain and critical areas.

Though rare, severe riverine flooding may shut down arterial parts of transportation systems. This could isolate neighborhoods or the entire City of Redmond. **Map 21, City of Redmond Vulnerable Transportation Networks**, shows transportation routes crossing the 100-year floodplain.

Transportation closures may limit businesses' abilities to operate normally. Businesses may be forced to close temporarily due to lack of patronage and/or employee absences. The disruption of delivery would also have negative impacts on the local economy. Small businesses are particularly vulnerable to temporary closures and property damage.

D. Populations

Hazard Specific

People with property located in the floodplain or within areas subject to seepage are vulnerable to flooding.

Isolated Populations

Transportation and road closures could isolate some neighborhoods. Due to the separation from downtown and major routes to the surrounding region, Education Hill may become isolated during an extreme flooding event. Services and supplies may be limited in the event of a flood.

Children

Flooding that occurs when children are separated from their families may result in limited resources and access to adequate transportation. Additionally, children may not know the proper precautions to take in the event of a flood.

Elderly

The elderly often have special medical or service needs that make isolation and road closures more serious problems for them compared to other vulnerable populations. **Map 22, City of Redmond Vulnerable Population Housing**, shows the location of retirement homes and senior housing. Three are located within or very near the floodplain. Two are located in the Northeast, which may become isolated.

Limited English Speakers

Residents with limited English proficiency may not have immediate access to emergency announcements, unless translation is provided. Additionally, language barriers may limit access to mitigation opportunities and opportunities to provide input in the Comprehensive Flood Hazard Management Plan. **Map 23, City of Redmond Limited English Language Capability in Floodplain**, shows the areas of limited English speakers.

Low-income Residents

Lack of adequate financial resources increases the vulnerability of low-income residents. This population may not be able to participate in costly mitigation efforts. Renters and mobile home owners may be limited to owner-initiated mitigation efforts. There is only one designated affordable housing⁷⁰ building within the floodplain. **Map 22, City of Redmond Vulnerable Population Housing**, shows the location of affordable housing relative to the floodplain. Households with limited income may face an additional hardship responding to flood damages or income losses.

6.3.3 Analyzing Development Trends

The City's Planning Department is currently focusing on an economic development plan to promote and advertise the existing businesses in the downtown area.⁷¹ One of the City's main goals in its Comprehensive Plan is to support vibrant concentrations of retail, office, service, residential, and recreational activity in the Downtown and Overlake neighborhoods. However, additional development in the floodplain will increase the City's vulnerabilities to flooding. While centralized, compact development will provide additional local services, dense development in the floodplain will change the impacts of flooding. Increasing the number of people and structures in the floodplain will increase the potential damages. Additionally, development will decrease permeability and thus increase runoff and the corresponding impacts.

6.4 Scenario

After three consistent days of rain, several reports of backed-up storm drains throughout the city are called in at 3 p.m. Thursday, April 10th. By that evening, ponding of one to two feet deep has occurred throughout the Sammamish valley. Saturated soils have slowed drainage and caused additional localized flooding from seepage. Twelve homes and three businesses in the floodplain have reported damage from the floodwaters. Three homes outside the floodplain have reported groundwater seepage in crawlspaces.

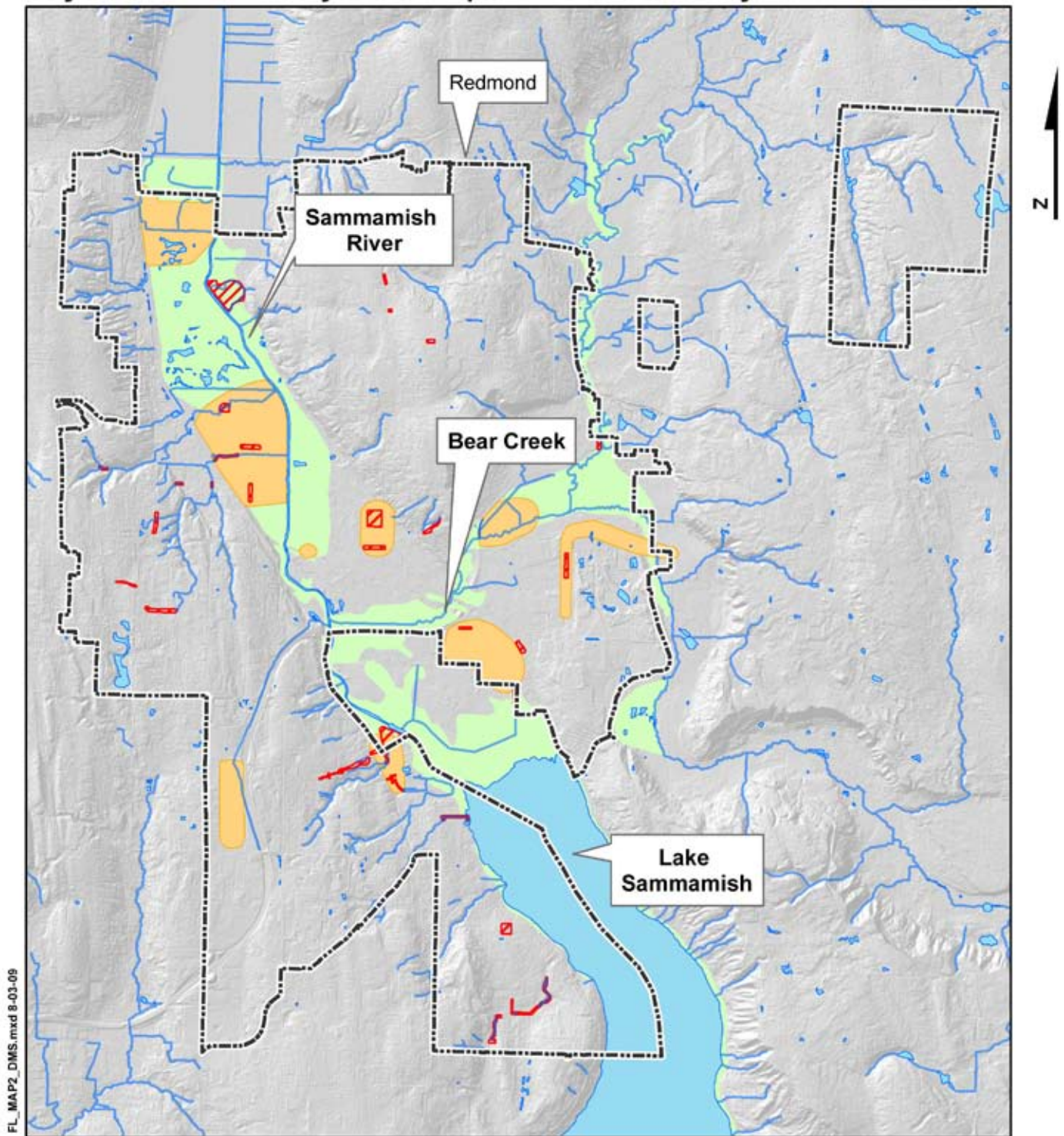
Although lakeside homes are cautious of flooding, landslides pose a greater threat. The saturated banks of Lake Sammamish are showing signs of movement and two homes have been evacuated.

⁷⁰ Buildings that have income restrictions are the only "affordable housing" units considered in this report. Information is limited for market-rate affordable housing.




⁷¹ Jim Roberts, City of Redmond Planning Department, informational interview, 2009.

Roads are extremely wet and flooding on West Lake Sammamish Parkway is limiting traffic to one lane. Businesses are operating on a limited basis due to the difficulty of traversing the valley. Several companies have encouraged employees to work from home. Weather reports predict continued rain.

City of Redmond 100-year Floodplain and Chronically Flooded Areas



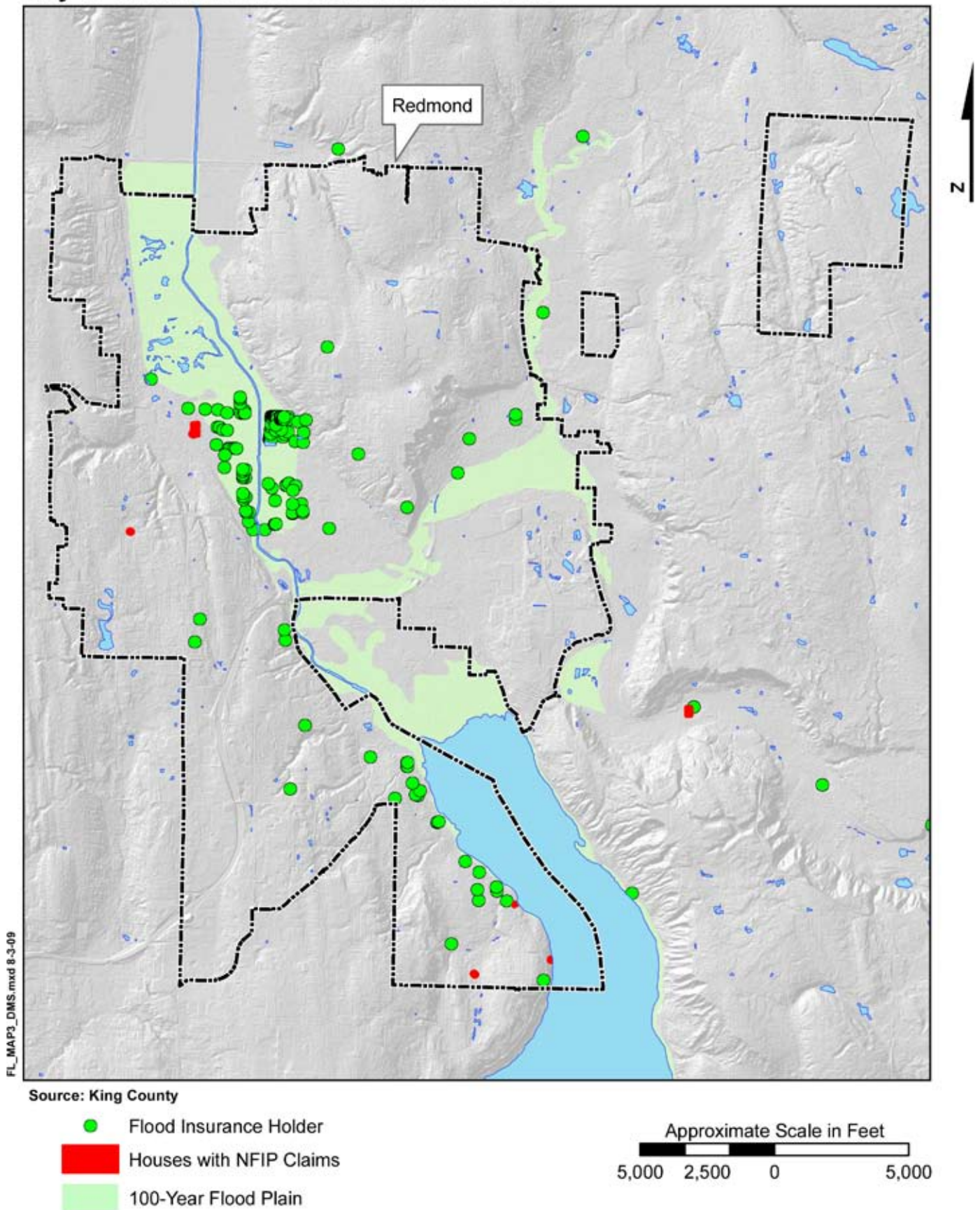
Source: King County

-  Flood Projects Identified
-  Chronic Flooding Areas
-  100 Year floodplain

Approximate Scale in Feet
 5,000 2,500 0 5,000

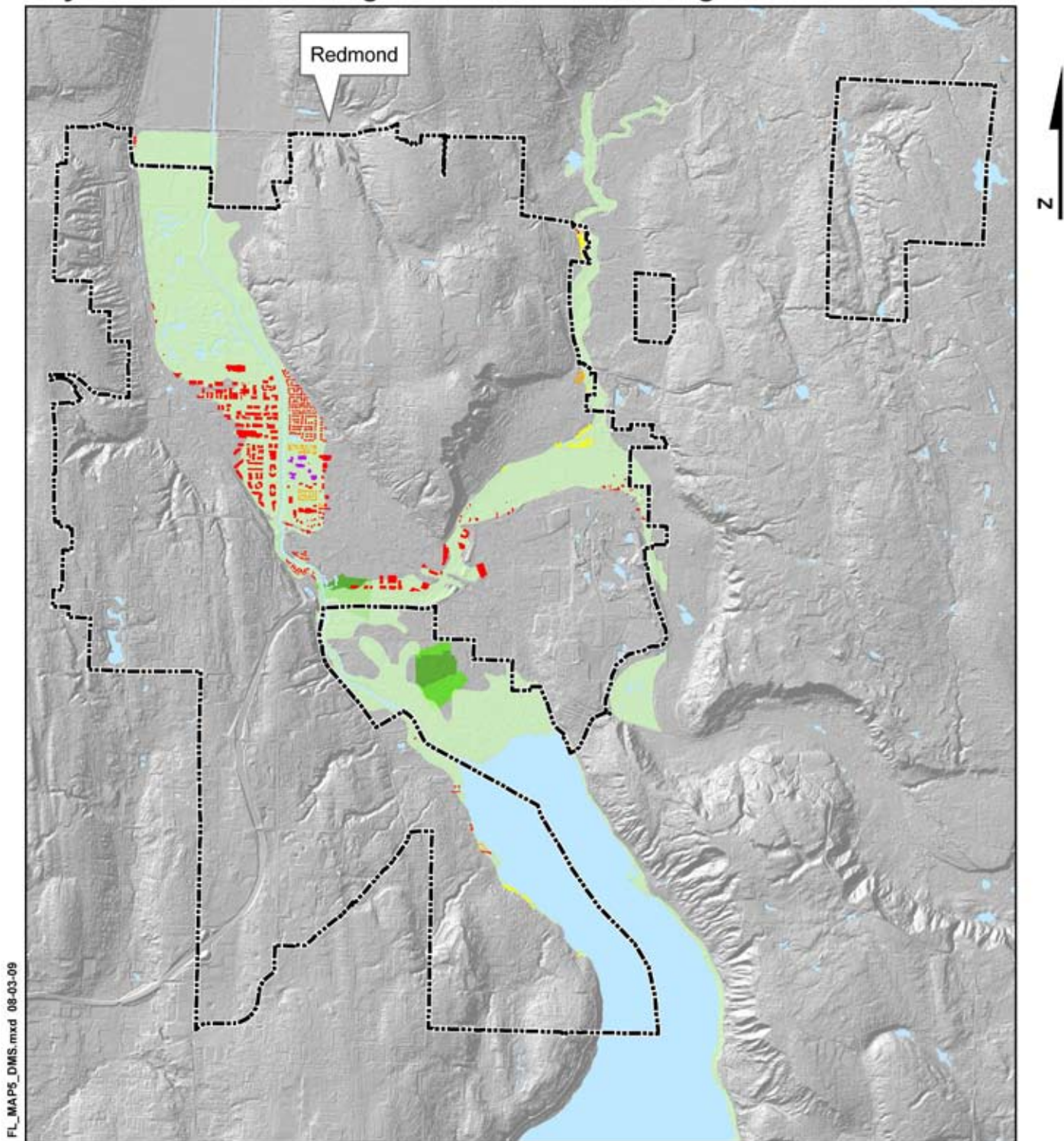
Map 16: City of Redmond 100-Year Floodplain and Chronically Flooded Areas
 Hazard Identification and Risk Assessment

City of Redmond NFIP Claims and Holders



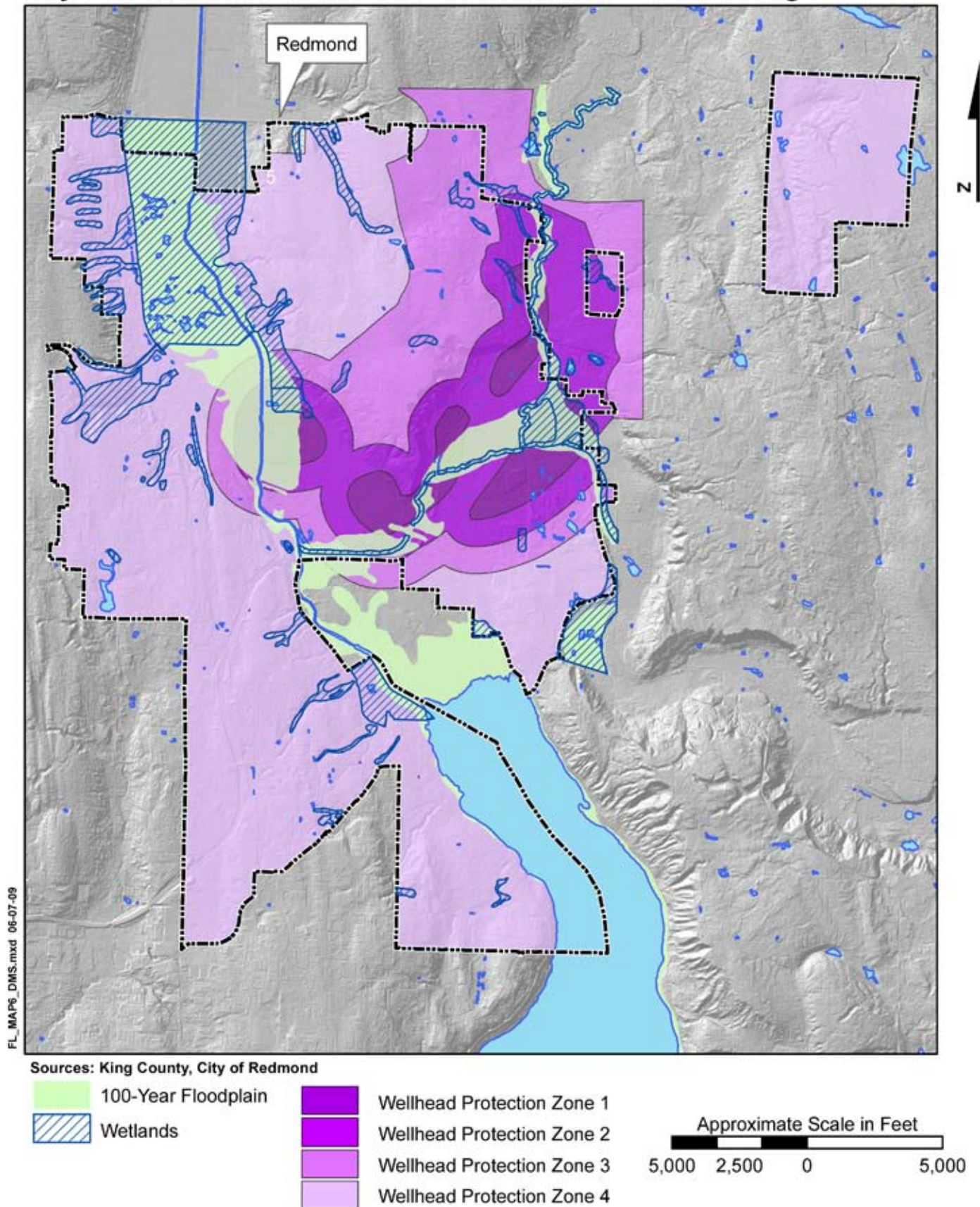
Map 17: City of Redmond NFIP Claims and Holders

City of Redmond Buildings Vulnerable to Flooding



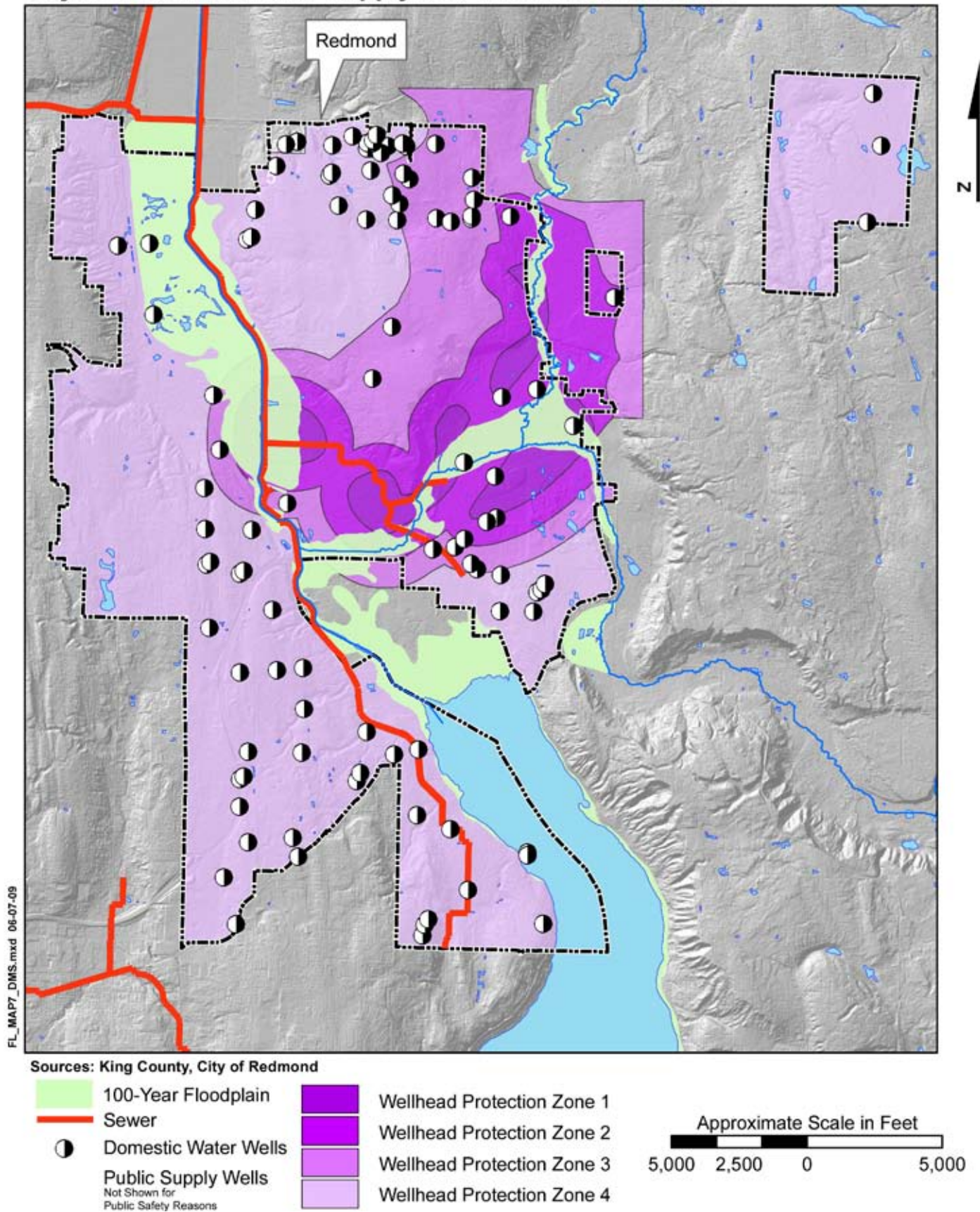
Map 18: City of Redmond Buildings Vulnerable to Flooding

City of Redmond Natural Environment Vulnerable to Flooding



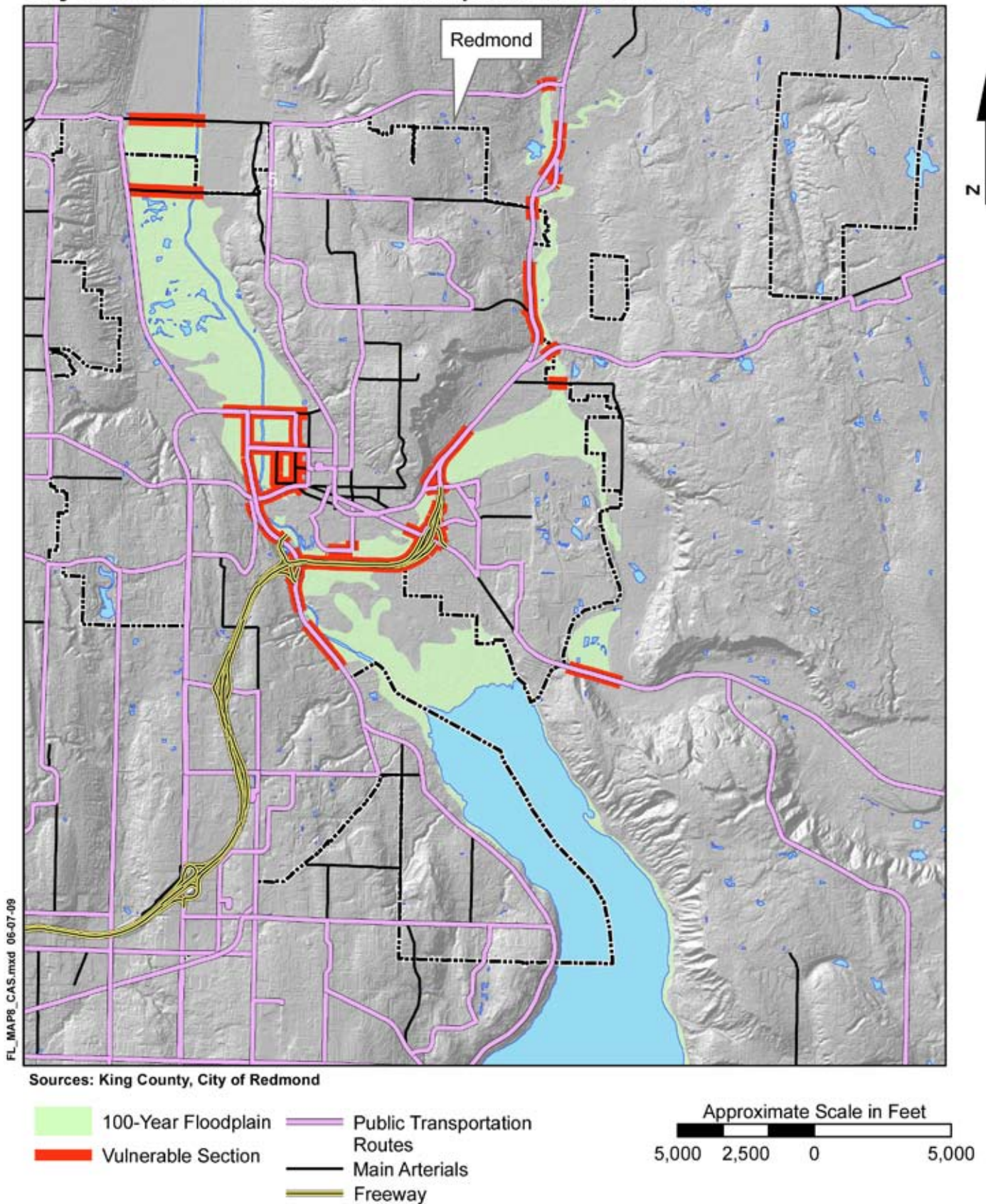
Map 19: City of Redmond Natural Environment Vulnerable to Flooding
 Hazard Identification and Risk Assessment

City of Redmond Water Supply and Sewer Infrastructure



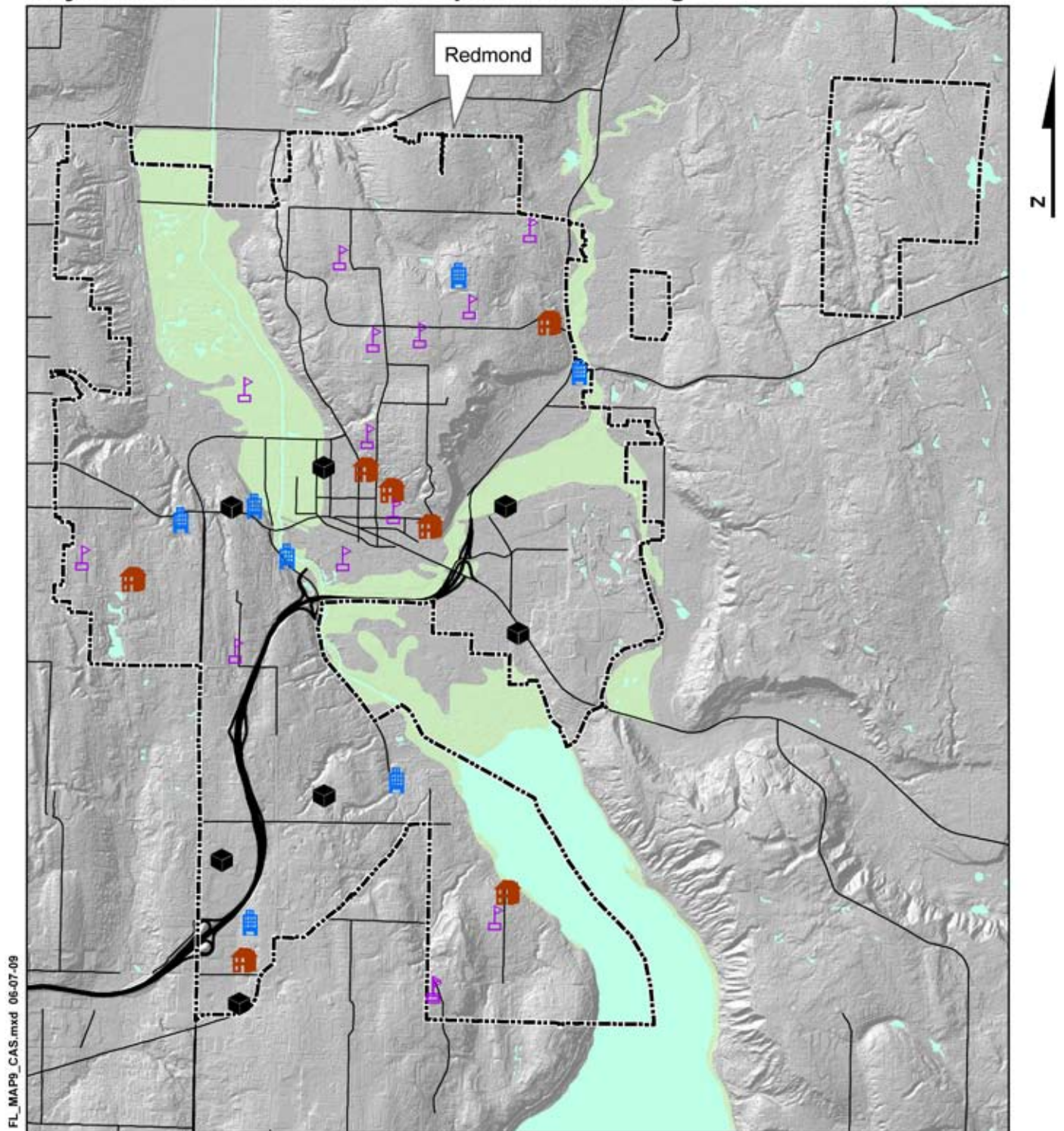
Map 20: City of Redmond Water Supply and Sewer Infrastructure
 Hazard Identification and Risk Assessment

City of Redmond Vulnerable Transportation Networks








Map 21: City of Redmond Vulnerable Transportation Networks
 Hazard Identification and Risk Assessment


City of Redmond Vulnerable Population Housing



Sources: King County, City of Redmond

- | | |
|---------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
|  100-Year Floodplain |  Daycare Facilities |
|  Retirement Homes |  Schools |
|  Affordable Housing | |

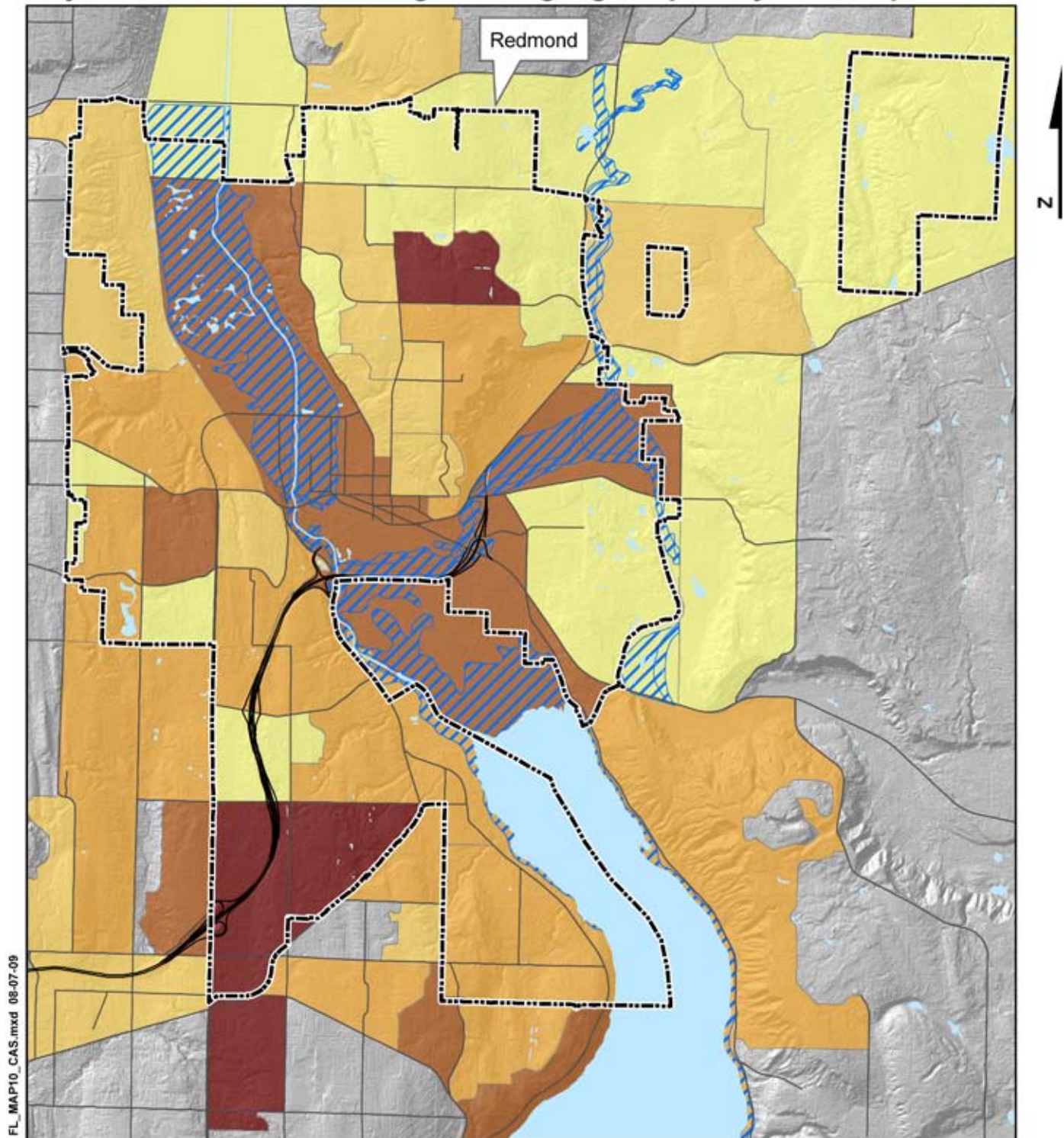
Approximate Scale in Feet



5,000 2,500 0 5,000

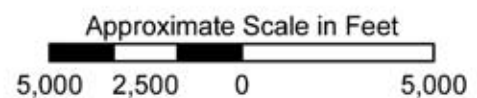
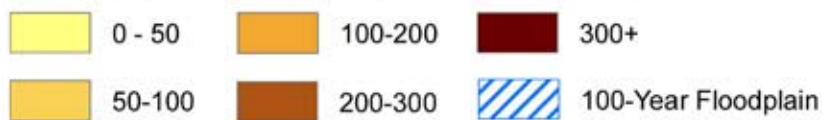
Map 22: City of Redmond Vulnerable Population Housing
 Hazard Identification and Risk Assessment

City of Redmond Limited English Language Capability in Floodplain



Sources: King County, US Census

Number of People with Limited English Language



Map 23: City of Redmond Limited English Language Capability in Floodplain

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Wildfires Risk Assessment

This plan is an update of the 2004 City of Redmond Hazard Mitigation Plan (HMP). Although it is an update, this document has been redesigned so that it looks, feels, and reads differently than the original. This is due to several factors: new hazard information has become available that drives new definitions of risk, the City has matured and new capabilities are now available, and the new format will allow readers to more easily understand the content. In addition, the 2004 HMP included several action items that have been completed, creating an opportunity for developing new mitigation strategies.

7.1 Identify Wildfires Hazards

A wildfire is natural or human caused uncontrolled burning of vegetative fuel such as grasslands, trees, or woodland.⁷² A wildfire that encroaches into or develops in areas such as residential neighborhoods or business districts is an urban/wildland interface fire.⁷³ As Redmond increases development in more open and undeveloped areas, the risk of urban/wildland fires increases.

Careless human activities cause 85% of wildfires in Washington State.⁷⁴ Some common human causes include: unattended outside fires, poorly extinguished campfires, fireworks, and cigarette butts thrown into dry vegetation. Naturally occurring fires, such as those sparked by lightning, are rare in Western Washington.⁷⁵

Additionally, east winds have been associated with increased wildfire danger in Western Washington, and often occur due to high-pressure systems that develop in the State's interior during late summer and early fall. When these systems and wind conditions occur, a dry, continental air mass affects western Washington, interrupting the usually damp, humid weather conditions.

Wildfires and urban/wildland interface fires can often be a secondary hazard to drought.⁷⁶ Droughts will result in drier canopy cover and increase the amount of available fuel for wildfires. A problem with the Olympic Pipeline could cause a fire or in the case of a fire, a leak from the Olympic Pipeline could exacerbate the magnitude of an existing fire.

⁷² Emergency Management Division, "Wildfire," Washington Military Department, http://www.emd.wa.gov/hazards/haz_wildfire.shtml.

⁷³ Office of Emergency Management, "Hazards and Disasters: Fire," King County, http://www.kingcounty.gov/safety/prepare/residents_business/Hazards_Disasters/Fire.aspx; and Resource Protection Division, "Wildfire Awareness," Washington State Department of Natural Resources, http://www.dnr.wa.gov/RecreationEducation/Topics/PreventionInformation/Pages/rp_prevent_wildfireawareness.aspx.

⁷⁴ Resource Protection Division, "Fire Information & Prevention," Washington State Department of Natural Resources, <http://www.dnr.wa.gov/RecreationEducation/FirePreventionAssistance/Pages/Home.aspx>.

⁷⁵ Emergency Management Division, "Hazard Profile – Wildland Fire," Washington Military Department, <http://www.emd.wa.gov/plans/documents/WildlandfireNov2007Tab5.10.pdf>.

⁷⁶ Emergency Management Division, "Wildfire," Washington Military Department, http://www.emd.wa.gov/hazards/haz_wildfire.shtml.

Climate Change

Climate change trends will significantly increase the chance of both drought and periods of severe heat. As weather patterns change and less moisture is present, foliage and canopy covers become more susceptible to wildfires. This change will increase both the severity and frequency of wildfires in the City of Redmond.⁷⁷

7.2 Profiling Wildfire Hazard Events

A. Location

Although Redmond currently has a low risk for wildfire and urban/wildland interface fires,⁷⁸ steep slopes with dense canopy are most at risk of a fire. Vegetation is the primary fuel for both types of fires, and because fire spreads more rapidly uphill than on flat terrain, steep slopes increase this risk. **Map 24, City of Redmond Areas of High Wildfire Risk**, shows the locations in Redmond with the greatest fire risk.

An additional factor for Redmond to consider is the location of the Olympic Pipeline, on the western edge of the City. A fire combined with a leak in the Olympic Pipeline would cause extensive damages. As illustrated in Map 24, there are portions of the pipeline that overlap with fire hazard areas.

B. Timing and Duration

Fire season for Washington State is typically early July to September or October, when the weather is the driest. This fire season tends to apply more to the eastern part of the State, which has a drier climate than Western Washington.⁷⁹ Redmond's location west of the Cascade Mountains experiences a damper climate than that of Eastern Washington.⁸⁰ This damper climate shortens Redmond's fire season.

C. Severity

The severity of both wildfires and urban/wildland interface fires is influenced by topography, vegetation, development patterns, the use of flammable landscaping and construction materials, and weather conditions. The severity of fires in Redmond varies depending on the type of fire.

A wildfire, primarily fueled by natural vegetation, can have a major impact in areas with dense canopy coverage, specifically areas of more undeveloped land. The severity of an interface fire will increase as urban development encroaches into areas previously undeveloped. Development may decrease the risk of wildfire, but the risk of interface fires will increase. As development continues, the man-made structures will provide fuel for fire and increase the severity of urban/wildland fires.⁸¹

77 Resource Protection Division, "2020 Strategic Plan for Wildland Fire Protection," Washington State Department of Natural Resources, http://www.dnr.wa.gov/RecreationEducation/Topics/FireInformation/Pages/rp_fire_2020strategicplan.aspx.

78 Resource Protection Division, "Communities at Risk," Washington State Department of Natural Resources, http://www.dnr.wa.gov/Publications/rp_burn_communitiesatrisk.pdf.

79 Emergency Management Division, "Wildfire," Washington Military Department, http://www.emd.wa.gov/hazards/haz_wildfire.shtml.

80 Resource Protection Division, "Fuel Moisture Graphs," Washington State Department of Natural Resources, http://www.dnr.wa.gov/SiteCollectionImages/Places/rp_fire_coast.jpg.

81 Resource Protection Division, "2020 Strategic Plan for Wildland Fire Protection," Washington State

D. Frequency*Previous Occurrences*

There has not been a significant urban/wildland interface fire recorded in King County since 1900.⁸²

Although the City of Redmond is not responsible for maintaining the Olympic Pipeline, it is important to consider the risk that the pipeline poses. Historically, there have been two serious pipeline-related fires in the Puget Sound Region. These incidents, in Bellingham (1999) and Renton (2004), resulted in major damage, significant injuries, and loss of life. There have not been any pipeline incidents in Redmond.

Probability of Future Events

Climate change will make Western Washington summers drier, thus increasing the risk of fire. New development in previously wooded or undeveloped areas, specifically in areas of high risk for wildfires, will increase the risk of urban/wildland interface fires.⁸³

7.3 Assessing Wildfires Vulnerability**7.3.1 Overview**

Redmond's vulnerability to wildfires is primarily concentrated on steep slopes with dense vegetation. Because wildfires spread so rapidly in these areas, plants and animals will have little time to react. Additionally, many of these areas of dense canopy cover on steep slopes contain excess dead and dry underbrush, which acts as fire propellant and can increase the intensity of a fire.⁸⁴

Homes near, or adjacent to, areas vulnerable to wildfires will have a higher risk of an urban/wildland interface fire. A fast-moving wildfire moving up a steep slope will quickly engulf a building at the top of the slope if the building is not adequately protected from fire. Thus, buildings and populations near areas with risk of wildfire will be more vulnerable to an urban/wildland fire.

7.3.2 Profiling the Vulnerabilities**A. Man-made**

During urban/wildland interface fires, man-made structures are at risk of being destroyed. Geospatial analysis was used to evaluate the number of buildings located in areas of steep slope and dense canopy coverage. As Redmond continues to grow,

Department of Natural Resources, http://www.dnr.wa.gov/RecreationEducation/Topics/FireInformation/Pages/rp_fire_2020strategicplan.aspx.

82 Emergency Management Division, "Hazard Profile – Wildland Fire," Washington Military Department, <http://www.emd.wa.gov/plans/documents/WildlandfireNov2007Tab5.10.pdf>.

83 Resource Protection Division, "2020 Strategic Plan for Wildland Fire Protection," Washington State Department of Natural Resources, http://www.dnr.wa.gov/RecreationEducation/Topics/FireInformation/Pages/rp_fire_2020strategicplan.aspx.

84 Emergency Management Division, "Hazard Profile – Wildland Fire," Washington Military Department, <http://www.emd.wa.gov/plans/documents/WildlandfireNov2007Tab5.10.pdf>.

and more structures are built on undeveloped land, the vulnerability of man-made structures will increase.

Table 15 shows the number and type of buildings located on steep vegetated slopes. As Redmond continues to grow, the currently vacant parcels will be developed and increase the number of vulnerable buildings.

Overland Fire Risk	
Type of Use	Buildings
Non-Residential	228
Multifamily	45
Single Family	513

Table 15: Number and Type of Buildings Vulnerable to Urban/Wildland Interface Fires
Source: Calculated from Washington State Geospatial Data Archive, "King County Data," University Libraries: University of Washington, <http://wagda.lib.washington.edu/>.

B. Natural

As previously noted, areas of dense canopy cover are extremely vulnerable to wildfire, particularly on steep slopes. A fire can temporarily alter or destroy a wooded habitat. Since fires are part of a natural cycle, the environment will recover from such a disturbance. However, urban development has made more species vulnerable, thus decreasing their resilience to a major disturbance such as a fire. Fires may also change the sedimentation and temperatures in rivers, stressing aquatic habitats.

C. Systems

Roads may be closed during a fire. Road closures may isolate neighborhoods and complicate evacuations. **Map 25, City of Redmond Roads Vulnerable to Wildfires**, highlights the sections of roads that may be compromised in a wildfire.

Although most utility lines are underground in Redmond, above ground electric transmission lines and cell towers may be impacted during an interface fire.

D. Populations

Map 26, City of Redmond Fire Risk and Vulnerable Populations, shows the location of facilities that concentrate vulnerable populations.

Hazard Specific

People who live or work near or in the fire hazard zone will face increased risk in the event of a fire.

Isolated Populations

People that live on, near, or require access through fire zones may become isolated during a fire. In the event of a large fire, compromised accessibility will complicate evacuation efforts.

Disabled Persons

People with limited mobility may experience additional difficulty in the event of a quick evacuation.

Children

Young people that are separated from their families may have limited mobility and insufficient knowledge about how to respond to a fire.

Elderly

Elderly people are more vulnerable to a fire if they have limited mobility or access to medical care. The elderly are more likely to have a compromised immune system and may have difficulty breathing smoke-filled air.

Limited English Language

People with limited English Language may not have sufficient access to mitigation or preparedness activities. Additionally, emergency announcements may not be adequate without translation.

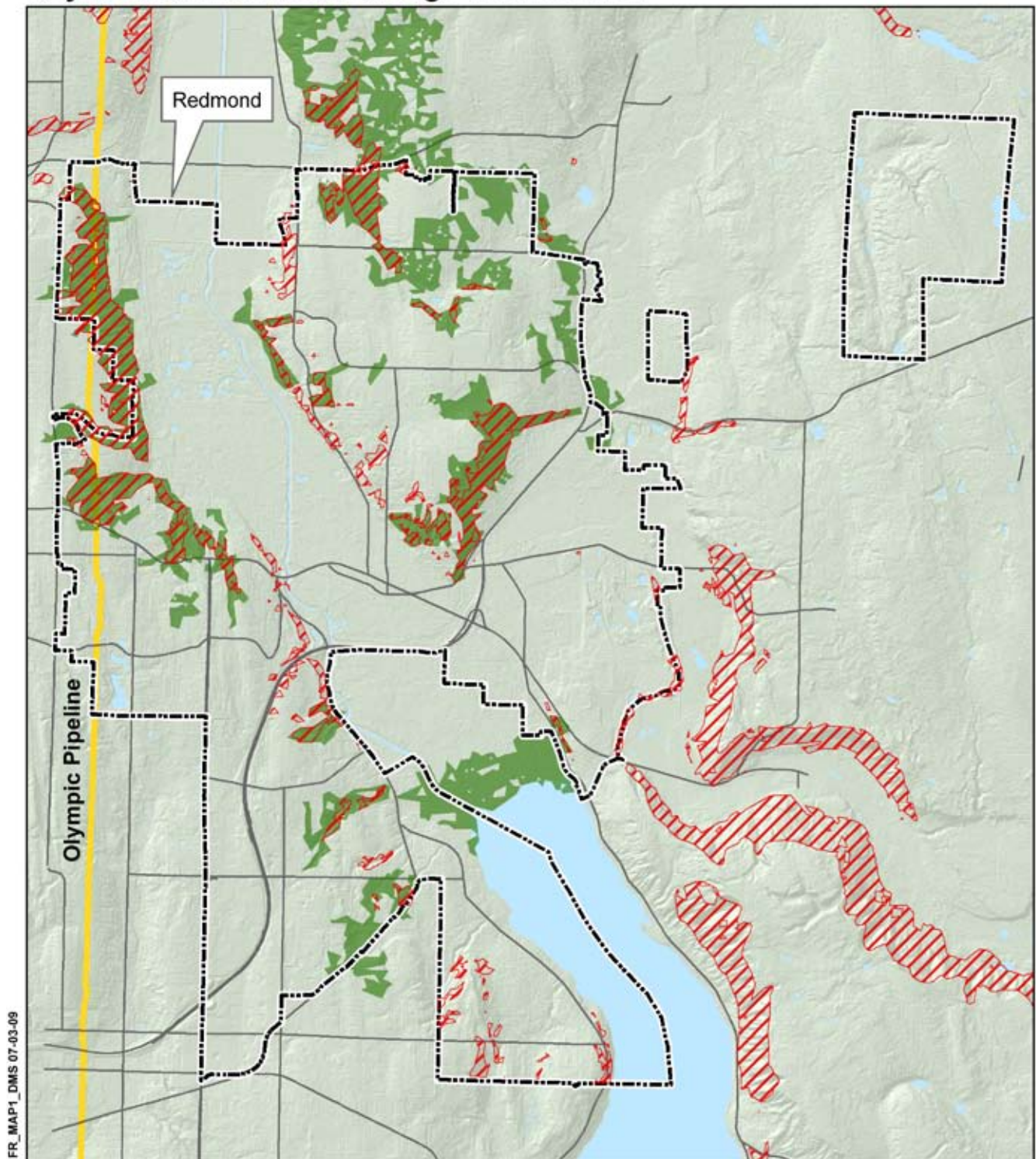
Low-income Residents

People with limited financial resources may be more vulnerable to the potential losses from a fire.

7.3.3 Analyzing Development Trends

As the greater Puget Sound Region continues to grow the City of Redmond will see a population increase within the City boundaries and in nearby jurisdictions. As new development pushes into previously undeveloped areas the risks from urban/wildland interface fire will increase. As weather patterns intensify due to climate change, previously damp conditions west of the Cascade will experience drier summers, increasing potential fuel sources for wildfires and urban/wildland interface fires.

City of Redmond Areas of High Wildfire Risk



Source: King County

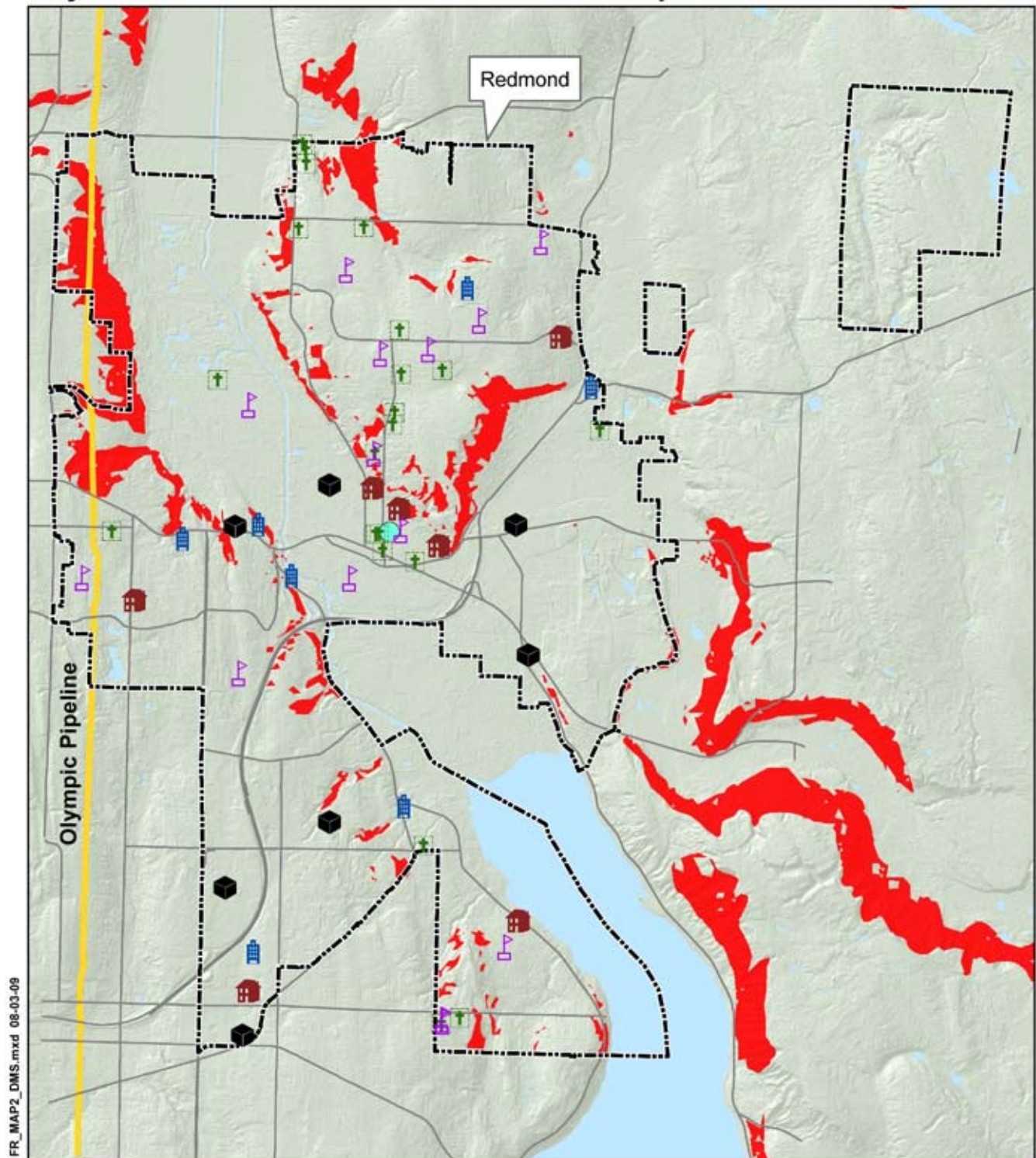
- Olympic Pipeline
- High Fire Risk
- More than 55% Canopy Coverage

Approximate Scale in Feet

5,000 2,500 0 5,000

Map 24: City of Redmond Areas of High Wildfire Risk

City of Redmond Fire Risk and Vulnerable Populations



Source: King County

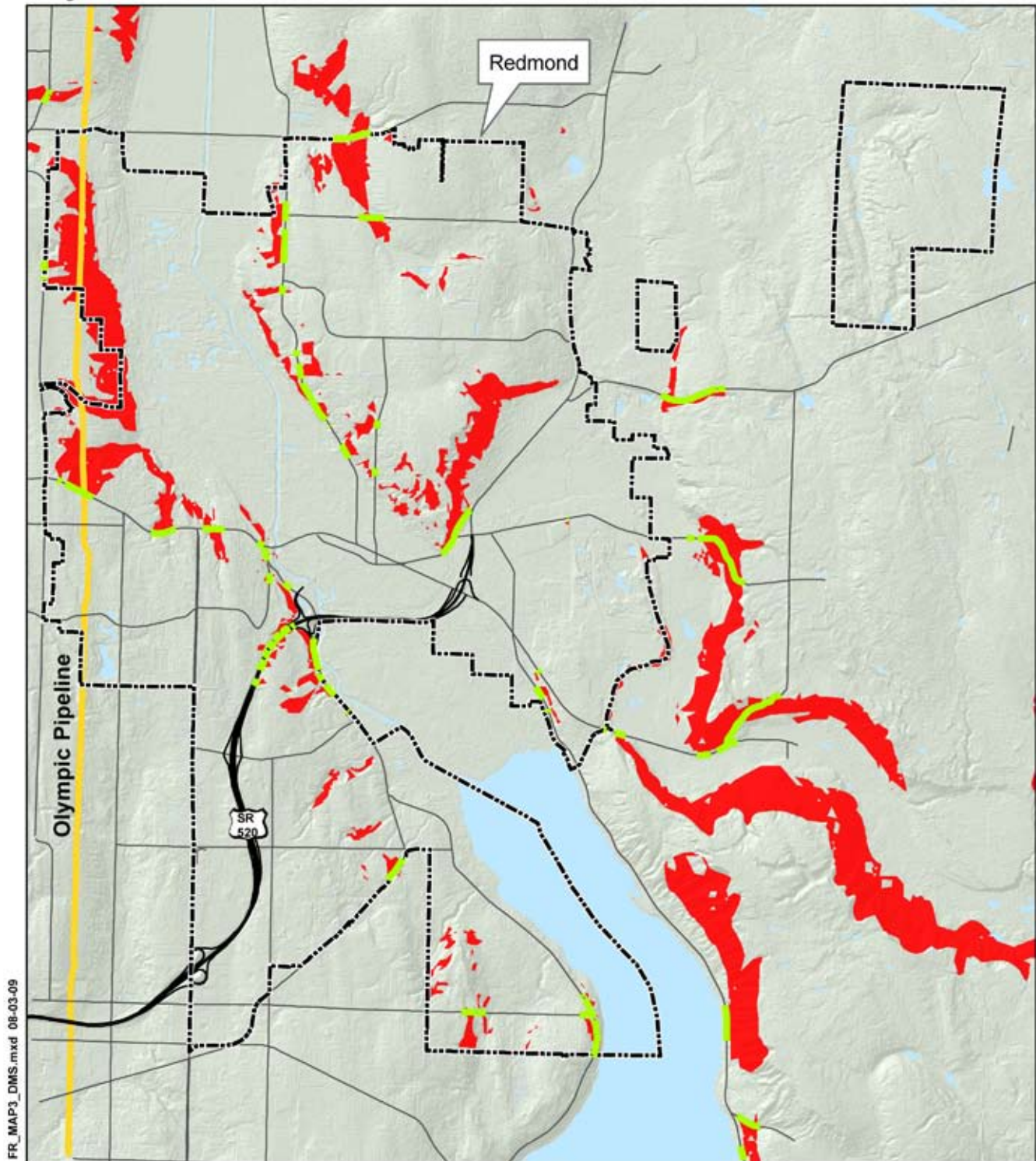
- | | | |
|--------------------|--------------------|----------------|
| Schools | Community Centers | High Fire Risk |
| Churches | Low Income Housing | |
| Daycare Facilities | Retirement Housing | |

Approximate Scale in Feet

5,000 2,500 0 5,000

Map 25: City of Redmond Fire Risk and Vulnerable Populations

City of Redmond Roads Vulnerable to Wildfires



- Major Arterial Roads
- Vulnerable Arterial Roads
- Areas of High Fire Risk
- Olympic Pipeline

Approximate Scale in Feet

5,000 2,500 0 5,000

Landslides Risk Assessment

This plan is an update of the 2004 City of Redmond Hazard Mitigation Plan (HMP). Although it is an update, this document has been redesigned so that it looks, feels, and reads differently than the original. This is due to several factors: new hazard information has become available that drives new definitions of risk, the City has matured and new capabilities are now available, and the new format will allow readers to more easily understand the content. In addition, the 2004 HMP included several action items that have been completed, creating an opportunity for developing new mitigation strategies.

8.1 Identify Landslide Hazards

A landslide is a movement of debris down a steep slope. The speed of the moving debris will vary from a slow creeping motion to a high-speed moving mass. Landslides are caused by a combination of factors, including geology, gravity, weather, and human activity. The steepness of a slope and the forces of gravity acting upon it are the main contributing forces of a landslide. For alluvial soils, on which much of Redmond sits, the angle of repose (the point at which a slope becomes unstable) is estimated to range from 30-35 degrees. Therefore, hillsides with a slope of greater than thirty degrees are landslide hazards.⁸⁵

Landslides occur when the soil is saturated, causing instability on hillsides. Saturated steep slopes may give way and pose a threat to the area on and near the hillside. Landslides may also occur as a secondary hazard after an earthquake or a severe storm. An earthquake during an extended period of rain would likely cause landslides. A large landslide that falls into Lake Sammamish could cause a seiche.

Factors that increase the likelihood of a landslide:

- Undercutting of a stream into a hillside
- Soil erosion/makeup
- Improper drainage on hillside
- Earthquakes
- Fires
- Intense periods of precipitation
- Lack of vegetation
- Improper development and drainage practices
- Alternate freezing and thawing

Landslides vary in both speed and size. The moving mass may be as narrow as a few feet or as wide as a few miles. Trees, roads, bridges, and homes may be swept away in the slide.

⁸⁵ Carson, M.A. and Kirkby, M.J., *Hillslope Form and Process*. West Nyack, New York, U.S.A. Cambridge University Press, 1972.

Climate Change

Climate change will increase the risk of landslides by exacerbating some of the factors listed above, such as increased precipitation events or vegetation-destroying wildfires.

8.2 Profiling Landslide Hazard Events

A. Location

Landslide hazard areas in Redmond are identified as slopes greater than thirty degrees and the areas within a fifty-foot buffer above and below such slopes. Steep slopes in Redmond are located primarily on the western and southeastern portion of Education Hill and along Redmond's northwestern border in the Willows/Rose Hill neighborhood.

Beyond the City limits there are several steep slopes surrounding Lake Sammamish and lining the Sammamish Plateau. A landslide on the slopes surrounding Lake Sammamish could result in a seiche. A seiche, sometimes called a lake tsunami, is an oscillating wave that occurs in an enclosed or semi-enclosed body of water.

Map 27, City of Redmond Landslide Hazard Areas and Major Vegetation, shows the hazard area along with the 50 foot buffer area. The King County Critical Areas Ordinance (CAO) designates critical slopes as hillsides with a slope of at least forty percent (approximated 21 degrees inclination) that are taller than ten feet. The CAO also includes a fifty-foot buffer (which can be waived for single family housing).⁸⁶

B. Timing and Duration

Soil saturation occurs primarily in the winter or spring, during Redmond's wettest months. Prolonged heavy rain will typically provide a few days warning prior to a slide. Signs of increased slope instability may indicate slopes that are most vulnerable during a particularly wet season. Irregular tree angles may present warning signs of past landslide occurrences. Close monitoring of structures built on or near the slopes may provide early indications of slides.

Slides can be slow, moving a couple of millimeters a year, or as fast as 200 miles per hour. Typical slides move at a rate of 30-50 miles per hour.⁸⁷ As a result of the fast movement, landslides are generally short in duration.

C. Severity

The speed of landslides can cause damage to structures and injure people. Slopes that are protected by the CAO remain in a natural, vegetative state, providing some ground stability. However, development and habitat alteration above the slopes may change the natural drainage patterns of stormwater run-off. While few structures appear to be constructed mid-slope (construction prior to the 1990 CAO were grandfathered in⁸⁸) on any of the steep hillsides in Redmond, some structures have

⁸⁶ King County Critical Areas Ordinance, "Chapter Two - Steep Slopes Hazard Area," King County, <http://your.kingcounty.gov/ddes/cao/Manual/II-SteepSlope.pdf>.

⁸⁷ United States Geological Survey, "Landslide Hazards Program," <http://landslides.usgs.gov/learning/faq/>.

⁸⁸ King County Critical Areas Ordinance, "Chapter Two - Steep Slopes Hazard," King County, <http://your.kingcounty.gov/ddes/cao/Manual/II-SteepSlope.pdf>.

been built on the edges above and below steep slopes, and are therefore susceptible to foundation damage and/or complete destruction of the structure by moving debris. **Map 27, City of Redmond Landslide Hazard Areas and Major Vegetation**, shows the steep slopes lacking vegetation.

D. Frequency

Previous Occurrences

Landslides have frequently caused disturbances in King County cities. The storms of 1996 and 1997 caused more than 100 landslides throughout the county. The 2001 Nisqually earthquake triggered a portion of road near Renton, WA to slide into the Cedar River.⁸⁹

Probability of Future Events

Climate change forecasts warn of an increase in frequency and severity in precipitation; thus landslides in Redmond are likely to become more frequent. Increased and intensified development on the hillsides and surrounding areas will change the character of runoff. Increased runoff elevates the landslide threat. Proper drainage practices, hillside terracing, and increased vegetation can stabilize hillsides and reduce the probability of landslides.

8.3 Assessing Landslide Vulnerability

8.3.1 Overview

In the United States, landslides cause 25-50 deaths and over \$1 billion in damages annually.⁹⁰ The built environment and drainage culverts are likely to be vulnerable during a landslide. Delicate fish and wildlife habitat will also be vulnerable to a landslide. Since landslides will happen in isolated areas, damage will be location specific.

8.3.2 Profiling the Vulnerabilities

A. Man-made

Redmond's natural geologic slopes and development on or near steep slopes make the built environment vulnerable. Approximately 10% of the residential structures in Redmond are located in the landslide hazard zone. About 9.5% of the non-residential (commercial and public) buildings are also within the designated buffer. **Map 28, City of Redmond Buildings in Landslide Hazard Areas**, shows the prevalence and location of commercial and residential structures located on, or within, the 50-foot buffer of slopes that are greater than 30%.

kingcounty.gov/ddes/cao/Manual/II-SteepSlope.pdf.

89 King County Office of Emergency Management, "Landslides," King County, http://www.kingcounty.gov/safety/prepare/residents_business/Hazards_Disasters/Landslides.aspx

90 United States Geological Survey, "Landslides Hazard Program," <http://landslides.usgs.gov/learning/ls101.php>.

B. Natural

A landslide may increase sedimentation and siltation in waterways, which may negatively impact fish and other wildlife habitat. A landslide may further destabilize a steep hillside and destroy trees and other vegetation, which may also impact wildlife habitat.

C. Systems

Roads and telecommunication networks may be vulnerable to a landslide. The location of the landslide will determine the impact. About 9.5% of the City's stormwater culverts are located within the 50-foot landslide buffer hazard zone. Damaged or blocked culverts may cause additional damage to the transportation system and provide subsequent obstacles for businesses (see **Map 29, City of Redmond Roads and Culverts in Landslide Hazard Areas**).

Slides, similar to earthquakes and other seismic activity, increase the vulnerability of telecommunication networks and infrastructure. Landslides generally impact all built forms and infrastructure within the affected area. Therefore, other utility infrastructure may also have increased exposure to risks if a landslide should take place in proximity to these systems.

Transportation systems are vulnerable to landslides. Damage may limit access for residents and employees in the City of Redmond. Emergency crew access could be limited by a landslide that makes roads unusable.

D. Populations

Refer to **Map 30, City of Redmond Populations Vulnerable to Landslides**, for the locations of vulnerable populations outlined below.

Hazard Specific

People who live or work near a steep slope are vulnerable in the event of a landslide. However, sufficient monitoring during periods of heavy rain may provide sufficient time for evacuation.

Isolated Populations

A landslide may isolate populations that live near a slide area. If a landslide impacts a road, and no alternate route exists, communities may become isolated. Specifically, Education Hill residents may become isolated in the event of a landslide that blocks roads.

Disabled Persons

In the case of a landslide, people with mobility constraints may have difficulty with a rapid evacuation.

Children

Children may become isolated from family members in the case of a landslide that affects the transportation system. Five schools and daycares are located within a

landslide hazards zone.

Elderly

Three retirement homes are located on steep slopes and two are located within close proximity to a steep slope. These facilities may be vulnerable to a landslide.

Limited English Language

Residents that do not have access to landslide hazard information in a language that they understand may not be able to adequately mitigate or have access to emergency information.

Low-income Residents

People with limited resources may not have the means to update their homes or relocate if necessary.

8.3.3 Analyzing Development Trends

The King County and City of Redmond Critical Area Ordinances (CAO) limit development on or near slopes that exceed a forty percent grade (approximately 21 degree incline) and are taller than ten feet. Although the Future Land Use Map of Redmond shows that much of the land in the landslide hazard zones are zoned residential and commercial, the CAO restricts potential development. However, development above and below steep hillsides (beyond the CAO fifty-foot buffer) may have a negative impact on the drainage and stability of the hillside. Development will alter the landslide hazard zone.

8.3.4 Redmond's Landslide History

Redmond has dealt with two significant landslides in their history dating back to 1997. In January, 1997, a severe winter storm (Federal Disaster 1159-DR-WA) caused localized flooding and overwhelmed storm drains and culverts in several locations in the City. A substantial landslide occurred on the southwest side of town when a hillside gave way due to excessive water overflowing storm drains and culverts at the top of the hill. The subsequent slide caused a road to be washed out.

In December, 2001, a water line broke as a result of a private development project at the top of a hillside. The resulting water flow overwhelmed a culvert caused slippage on the adjacent hillside. This slide occurred on the south west side of town off of 24th Ave NE. (See Maps 27, 28). The slide actually occurred on private property.

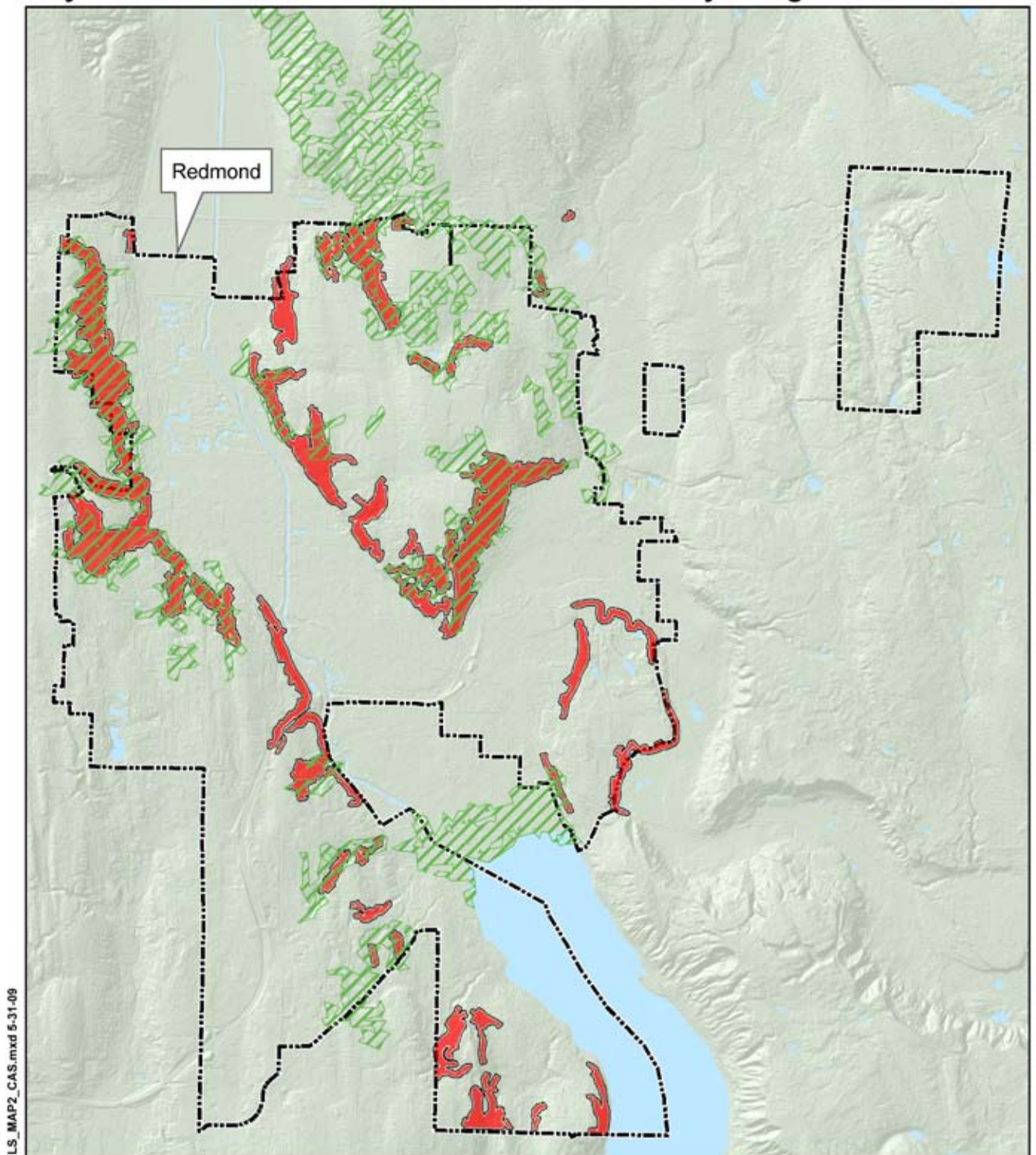
These two landslides listed above have led to a Public Works review of the storm drain capacity in Redmond and some changes to the development codes for residential and commercial development. In addition, Redmond conducted a review of its policy relating to regular street cleaning and storm drain clearing that ultimately included messaging to Redmond residents encouraging them to regularly check storm drains

in their neighborhoods. Redmond has also modified its procedures for monitoring construction during poor weather times to ensure that necessary precautions are taken to keep hillsides stable.




8.4 Scenarios

At 10 p.m. on November 5th, after several weeks of rain, a section of hillside in the Education Hill area gave way. Three homes slid fifty feet down the hillside, depositing debris in the backyards of several other homes, which were not damaged directly but lost landscaping and auxiliary structures, such as storage sheds. The residents and the City are cleaning up the large amounts of debris. Five people were injured, but there were no life-threatening injuries. Although neighboring homes are currently stable, monitoring will continue as the section that gave way continues to occasionally crumble. The road above the hill has been closed due to instability. The debris blocked a culvert at the bottom of the hill and caused two feet of flooding on sections of SR-202, Redmond-Woodinville Road. The road was closed for thirty-six hours before crews were able to restore normal traffic flow.

City of Redmond Landslide Hazard Areas and Major Vegetation

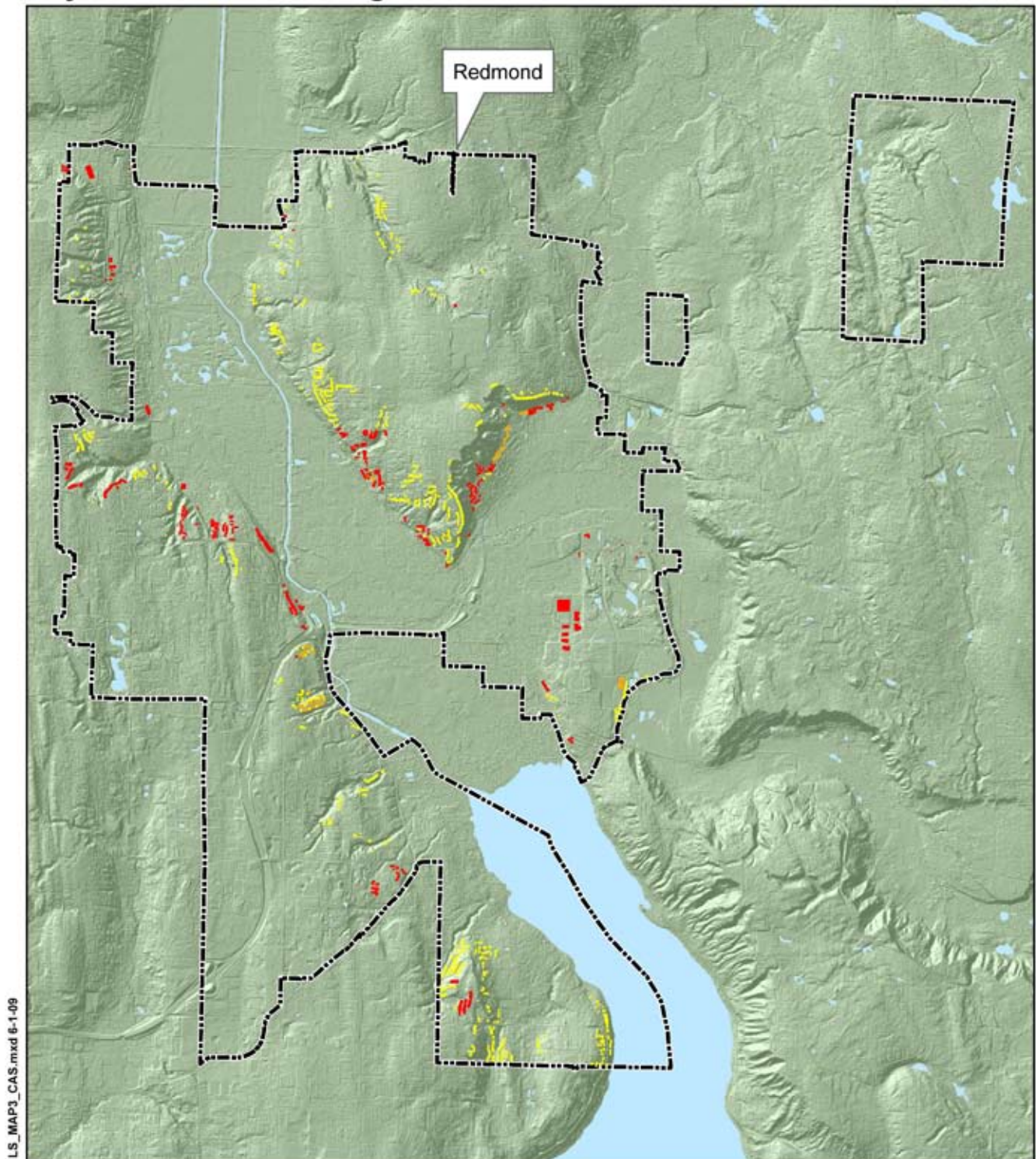


Source: King County

-  Major Vegetation
-  Landslide Hazard Area
-  50 Foot Buffer

Approximate Scale in Feet

5,000 2,500 0 5,000

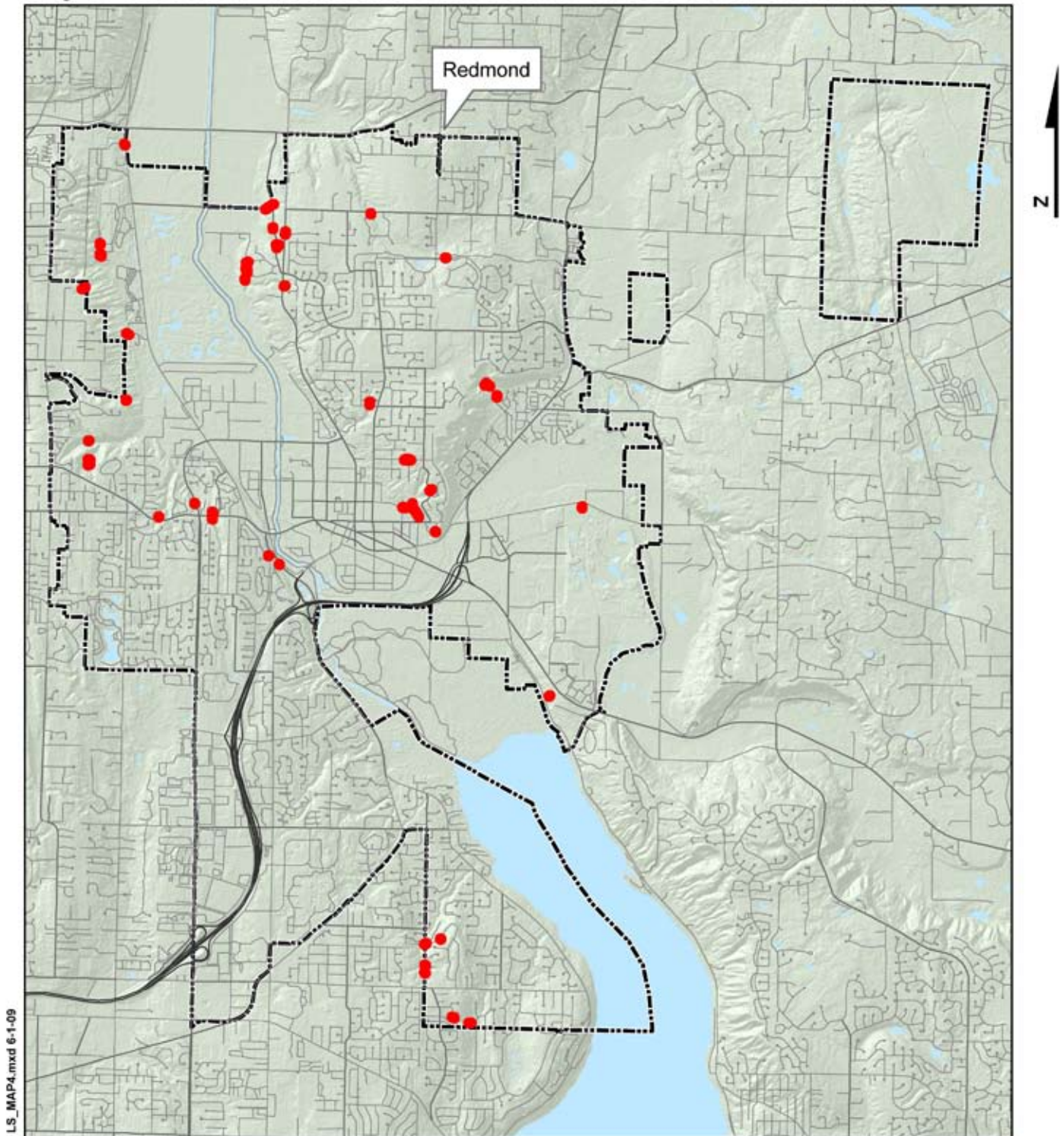
City of Redmond Buildings in Landslide Hazard Areas

Source: King County

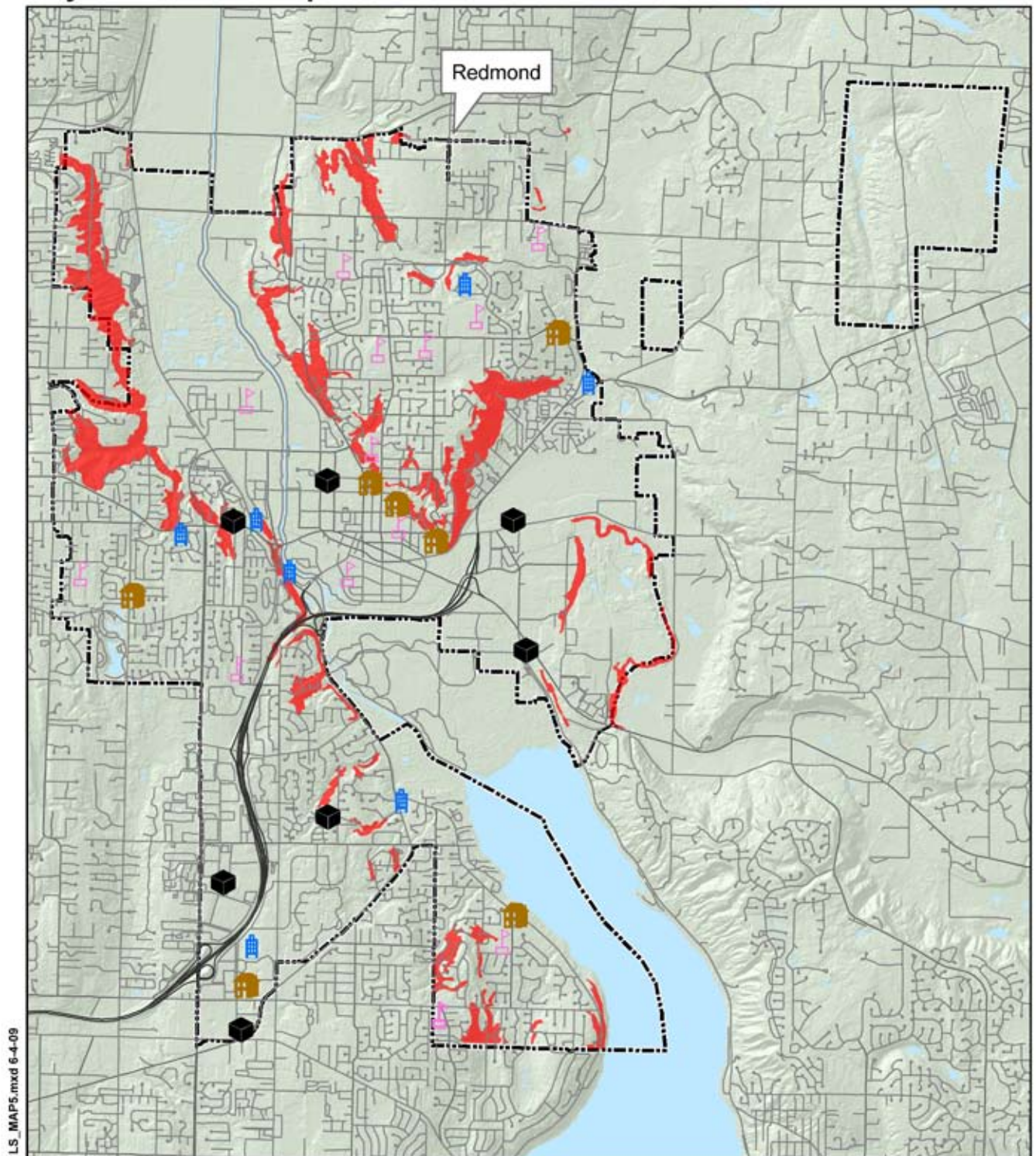
- Multifamily Buildings
- Single Family Buildings
- Commercial Buildings

Approximate Scale in Feet
5,000 2,500 0 5,000

City of Redmond Roads and Culverts in Landslide Hazard Areas



City of Redmond Populations Vulnerable to Landslides



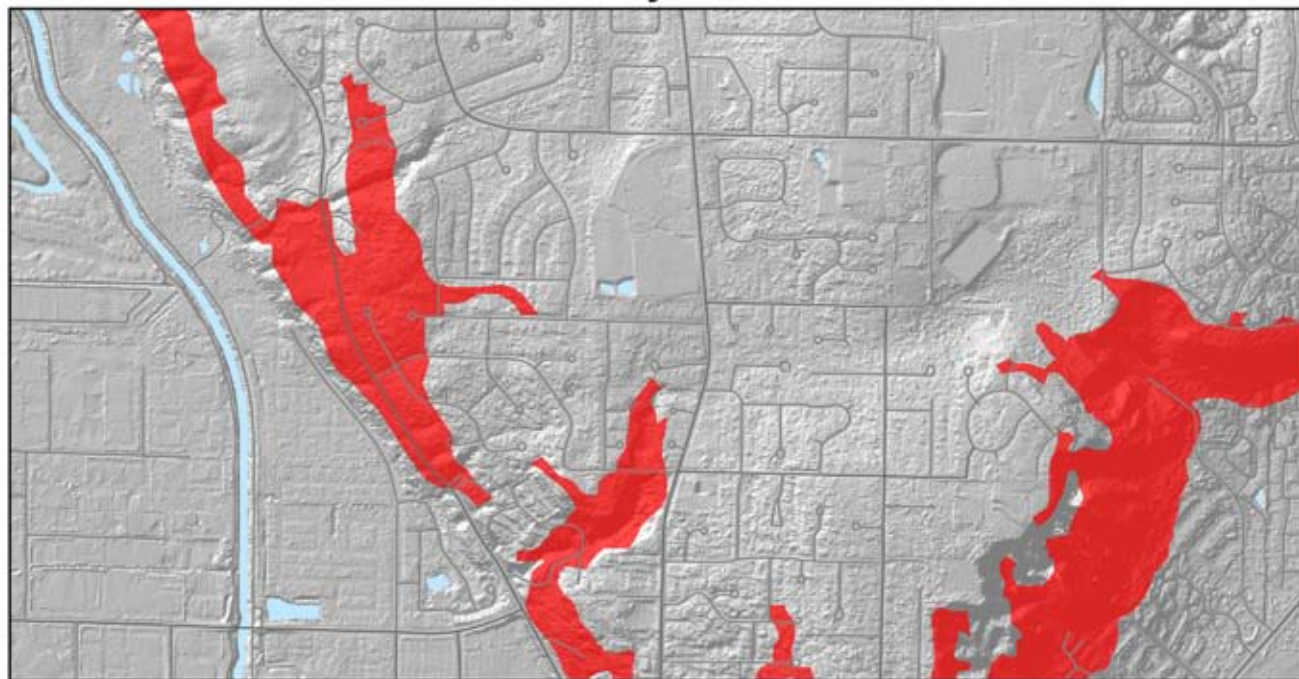
Source: King County

-  Daycare
-  Affordable Housing
-  School
-  Landslide Hazard Area
-  Retirement Home

Approximate Scale in Feet

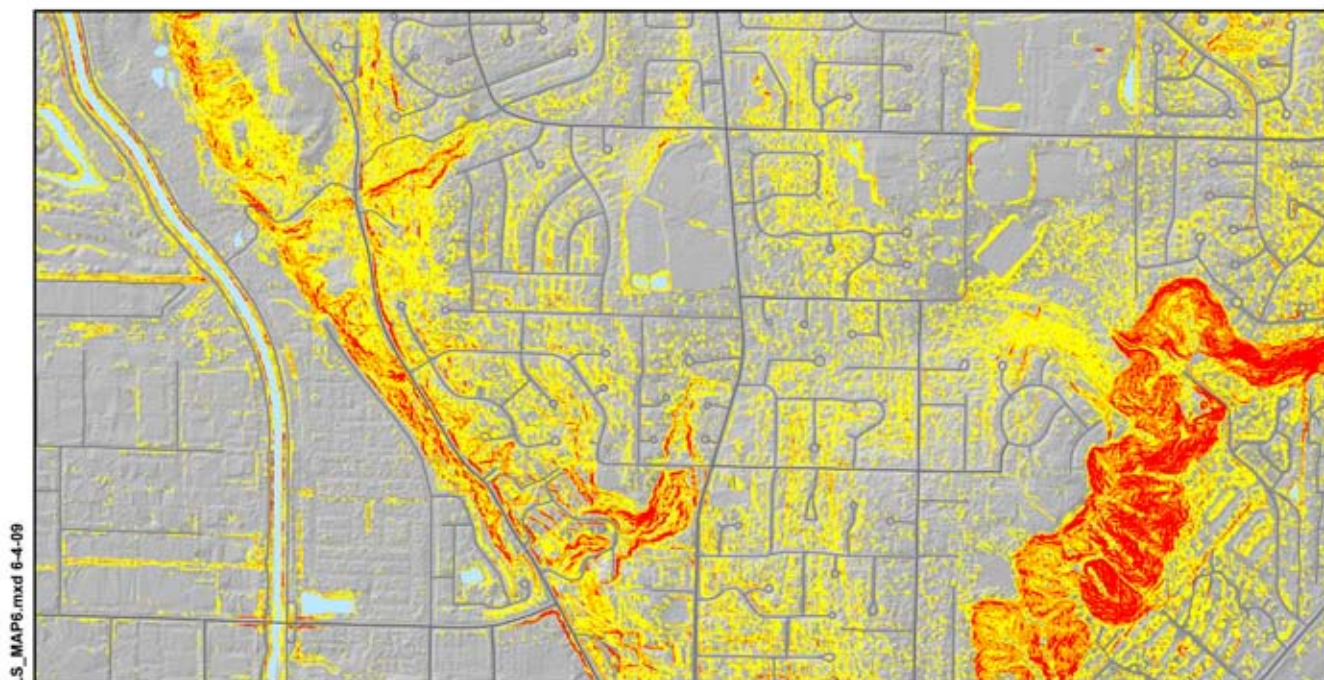
5,000 2,500 0 5,000

Differences Between Current County Data and KC LiDAR Data



Landslide Hazard Area

Current County Data





Source: King County

KC LiDAR Data

- 10 - 20 Degree Slope
- 20 - 30 Degree Slope
- >30 Degree Slope

Approximate Scale in Feet
 1,500 750 0 1,500

Map 31: Differences Between Current County Data and KC LiDAR Data



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Pandemics Risk Assessment

This plan is an update of the 2004 City of Redmond Hazard Mitigation Plan (HMP). Although it is an update, this document has been redesigned so that it looks, feels, and reads differently than the original. This is due to several factors: new hazard information has become available that drives new definitions of risk, the City has matured and new capabilities are now available, and the new format will allow readers to more easily understand the content. In addition, the 2004 HMP included several action items that have been completed, creating an opportunity for developing new mitigation strategies.

9.1 Identify Pandemic Hazards

Pandemics are characterized by the emergence of a new infectious disease that causes serious illness and spreads easily among humans. Since pandemics involve new diseases, there are often no vaccines and little natural immunity to thwart the spread of the epidemic.

Pandemics spread quickly through communities, nationally or even globally. Generally, the elderly, young children, and people with pre-existing illnesses are most vulnerable to a pandemic. However, some pandemics such as the H1N1 Influenza outbreak of 2009 and the Influenza Outbreak of 1918-1919 have defied this pattern by primarily affecting otherwise healthy individuals⁹¹.

Many types of diseases can result in a pandemic. In the 14th century, the Bubonic Plague pandemic in Europe killed around 75 million people in a four-year period.⁹² More recently, the Influenza pandemic of 1918-1919 was responsible for millions of deaths worldwide.⁹³ New, emerging diseases such as Severe Acute Respiratory Syndrome (SARS) or the H1N1 Flu (Swine Flu) are causes for concern. The World Health Organization (WHO) has created a pandemic alert system for influenza-like viruses; shown in **Table 16**.

91 Tara Smith, "Swine flu and deaths in healthy adults--cytokine storm?" Aetiology April 26, 2009, http://scienceblogs.com/aetiology/2009/04/swine_flu_and_deaths_in_health.php.

92 Will Dunham, "Black death 'discriminated' between victims," ABC Science, January 29, 2008, <http://www.abc.net.au/science/articles/2008/01/29/2149185.htm>.

93 Jeffery Taubenberger and David Morens, "1918 Influenza: the Mother of All Pandemics," Emerging Infectious Diseases 12 no. 3 (2006), <http://www.cdc.gov/ncidod/eid/vol12no01/05-0979.htm>.

World Health Organization Pandemic Alert System Phases	
Phase 1	No viruses circulating among animals have been reported to cause infections in humans.
Phase 2	An animal influenza virus circulating among domesticated or wild animals is known to have caused infection in humans, and is therefore considered a potential pandemic threat.
Phase 3	An animal or human-animal influenza virus has caused sporadic cases or small clusters of disease in people, but has not resulted in human-to-human transmission sufficient to sustain community-level outbreaks.
Phase 4	Verified human-to-human transmission of an animal or human-animal influenza virus able to cause “community-level outbreaks.” The ability to cause sustained disease outbreaks in a community marks a significant upwards shift in the risk for a pandemic.
Phase 5	Human-to-human spread of the virus into at least two countries in one WHO region. While most countries will not be affected at this stage, the declaration of Phase 5 is a strong signal that a pandemic is imminent and that the time to finalize the organization, communication, and implementation of the planned mitigation measures is short.
Phase 6	This Pandemic phase is characterized by community level outbreaks in at least one other country in a different WHO region in addition to the criteria defined in Phase 5. Designation of this phase will indicate that a global pandemic is under way.
Post-Peak Period	Pandemic disease levels in most countries with adequate surveillance will have dropped below peak observed levels. The post-peak period signifies that pandemic activity appears to be decreasing; however, it is uncertain if additional waves will occur and countries will need to be prepared for a second wave.
Post-Pandemic Period	Influenza disease activity will have returned to levels normally seen for seasonal influenza. It is expected that the pandemic virus will behave as a seasonal Influenza A virus.

Table 16: World Health Organization Pandemic Alert System Phases

Source: World Health Organization, “Current WHO Phase of Pandemic Alert,” https://www.who.int/csr/disease/avian_influenza/phase/en/.

The primary concern when a pandemic occurs is severe illness and potential loss of life. However, it may have cascading effects on the economy and burden strained existing resources.

A pandemic may cause disruptions in the local economy. Schools and businesses may close either to stop the spread of the disease or due to employee absence. The financial losses due to business closure may be significant. The economic implication of a pandemic is more thoroughly explained in Section 9.3.2.C, Profiling the Vulnerabilities, Systems.

A pandemic will overburden existing services. This will increase emergency response times and demand for health care facilities. In a severe pandemic, public transportation may shut down in order to prevent the spread of diseases. Grocery stores and other service providers may be similarly impacted.

In the event of a pandemic, the WHO and the U.S. Center for Disease Control and

Prevention (CDC) direct response efforts. Depending on the severity of the outbreak, local or national public health agencies may also respond.

9.2 Profiling Pandemic Events

A. Location

All of Redmond is vulnerable during a pandemic. The disease agents (bacteria, viruses, parasites) responsible for a pandemic are more likely to be transmitted in areas with a high human-to-human or human-to-animal contact. Despite Redmond's relatively low residential population density; the large business centers, schools, and retirement homes concentrate large numbers of people. These public gathering places are locations where disease can spread rapidly.

Locations in Redmond that involve large numbers of domestic and international travel, such as hotels or business centers, should be noted as possible locations for the spread of diseases. During the SARS outbreak of 2003, an outbreak of the disease in a hotel was found to be the source of its spread across the globe.⁹⁴ Large businesses in Redmond often require extensive business travel outside the region, increasing Redmond's risk of exposure to new diseases.

B. Timing and Duration

Pandemics do not have a predictable time component. The duration of a pandemic may be much longer than many other hazards. The Washington State Department of Health warns, "An Influenza pandemic will most likely not be a short, sharp event leading immediately to commencement of a recovery phase, as would be the case in an earthquake. A pandemic may last several months, as was the case of the 1918 influenza pandemic, and may contain peaks followed by periods of reduced illness."⁹⁵

The ability of local, regional and national medical organizations to prepare for, and respond to, an outbreak will affect the duration of the pandemic. Additionally, the type of disease, number of people infected, and the means by which the disease is transmitted will determine the rate at which the disease will spread. For example, a microorganism that only has the ability to spread via blood contact will spread less quickly than one that has the ability to be transmitted through the air or by contact with contaminated objects.

C. Severity

The severity of a pandemic depends on the disease itself and the method of transmission. A disease that is air-borne and spreads human-to-human could be catastrophic. Once such a disease develops, it has the potential to spread rapidly causing outbreaks around the world, causing many deaths. The CDC predicts that as much as 25% to 30% of the United States' population can be affected by a pandemic

94 World Health Organization, "Communicable Disease Surveillance and Response: Severe Acute Respiratory Syndrome (SARS)," http://www.who.int/csr/media/sars_wha.pdf.

95 Washington State Department of Health, "Pandemic Influenza Planning Guide for State Agencies," <http://www.doh.wa.gov/panflu/pdf/StateAgencyPanFluGuide.pdf>, 5.

outbreak. In King County that prediction translates to about 540,000 infected people and 11,500 deaths. **Table 17, Selected Diseases, Severity and Method of Transmission**, provides details about previous outbreaks.

Selected diseases, severity and method of transmission						
Disease	Estimated Mortality Rate	Transmission Methods				Notes
		Airborne	Contaminated surfaces	Blood or direct body fluid contact	Animal to Human	
SARS	10%	Maybe	Yes	Yes	Yes	SARS is still considered a rare disease with the last case reported on July 11, 2003.
H1N1 Influenza	0.46%**	Yes	Yes	Yes	Yes	In the past the disease spread to humans mainly via contact with infected pigs. In April 2009, a mutated form that spreads between humans was identified in Mexico. The exact severity of this disease is still under speculation.
Avian Influenza	60%	No	No	Yes	Yes	Frequency of the disease has been low and limited to a few regions around the world due to limited human to human transmission.
Food-borne Illness	minimal	No	No	No	via contaminated food	While food poisoning illness can be severe, outbreaks are limited to people who consumed the infected food source.
Ebola	69%	No	No	Yes	Yes	The spread of Ebola has so far been limited but the virulent nature of this disease is a cause for concern. The virus causes fatal hemorrhaging disease in humans and can be spread via close bodily contact. Some strains of the virus have been demonstrated to be spread airborne between monkeys. A mutation of the disease in the human population could trigger a major worldwide pandemic.
West Nile Virus	3%	No	No	No	Yes	West Nile Virus can only be transmitted to humans via mosquito bites. Frequency of human infection depends on the prevalence of infected mosquitoes. The disease first appeared in North America in 1999, resulting in thousands of flu-like infections throughout the US. It has manifest as fatal encephalitis in certain people.

Table 17: Selected Diseases, Severity and Method of Transmission

Source: Centers for Disease Control and Prevention – Diseases and Conditions <http://www.cdc.gov/DiseasesConditions/>

** As of June 6, 2009. Calculated from total confirmed cases and deaths. Figure subject to change.

D. Frequency

Previous Occurrences

There are no recent cases of pandemics affecting Redmond directly, but the U.S. has experienced four influenza pandemics in the 20th century. The pandemic of 1918-19 was the most severe pandemic on record, killing 650,000 Americans, and 50 million or more worldwide. The most recent occurrence of influenza pandemic is the 2009 outbreak of H1N1 Influenza (Swine Flu). As of July 6, 2009, 136 countries had officially reported over 94,000 confirmed cases of the influenza infection and 429 deaths.⁹⁶

Probability of future events

King County Health Services Communicable Disease Center warns that in the presence of a growing population, there are more opportunities for infectious diseases to occur and spread. From 2000-2007 Redmond's population increased roughly 10%.⁹⁷ The increases in population, paired with increases in international travel, suggest that Redmond is more likely to be affected by a pandemic in the future.

Climate change is another factor that will increase the probability of future pandemics. Rising temperatures enable carriers of disease, such as insects and rodents, to expand their geographic range and thus the ability to infect people.⁹⁸ Additionally, milder winters and longer summers increase the ability of warm-climate diseases to survive in previously colder climates. When diseases migrate, the local population will have little immunity to new diseases. Local healthcare providers may have limited knowledge or familiarity with these diseases, and thus be unprepared to diagnose and treat them.⁹⁹ These changing variables make it difficult to establish a definite probability for pandemic events.

9.3 Assessing Pandemic Vulnerability

9.3.1 Overview

While a pandemic will not affect man-made structures or the environment, large numbers of fatalities and economic loss may occur. Redmond is home to many large multinational businesses that involve both international and domestic travel, increasing the chances that new infectious diseases may appear there. Redmond contains large numbers of vulnerable populations who may be adversely affected by a pandemic disease outbreak.

⁹⁶ World Health Organization, "Influenza A(H1N1) - Update 58," http://www.who.int/csr/don/2009_07_06/en/index.html.

⁹⁷ American FactFinder, "2007 Population estimates," U.S. Census Bureau, http://factfinder.census.gov/servlet/GCTTable?_ds_name=PEP_2007_EST&-mt_name=PEP_2007_EST_GCTT1R_ST9S&-geo_id=04000US53&-format=ST-9&-tree_id=806&-context=gct.

⁹⁸ Rick Smith, "Is Climate Change Aiding Spread of Disease?" International Herald Tribune, September, 2002, http://news.nationalgeographic.com/news/2002/09/0920_020910_climatedisease.html.

⁹⁹ Richard Bissel, Andrew Bumbak, Matthew Levy and Patrick Echebi, "The Threat of Infectious Disease in a Global Community," *Journal of Emergency Management* 7 (2009): 19-35.

9.3.2 Profiling the Vulnerabilities

A. Man-made

The man-made environment, including built structures and infrastructure, is not vulnerable in the event of a pandemic.

B. Natural

While some wildlife may suffer from zoonotic diseases that are transferred between humans and animals, the natural environment is unlikely to be affected as a result of a pandemic.

C. Systems

In the event of a catastrophic pandemic, community systems in Redmond will be severely strained. There are no hospitals within the City limits to treat ill residents; therefore, neighboring jurisdictions are likely to be overwhelmed with patients from Redmond. An increase in deaths resulting from a pandemic may overflow morgues. Medical staff may become ill, resulting in staff shortages. The CDC estimates 540,000 infections in King County could occur during a severe or 1918-level pandemic flu outbreak. This prediction includes 270,000 in need of outpatient care and nearly 60,000 in need of hospitalization. These levels would overwhelm existing regional medical and emergency services.¹⁰⁰

The economy of Redmond may be severely impacted by loss of productivity, resulting from business closures and isolation. During peaks of a significant pandemic, staff absences could be as high as 50%.¹⁰¹ Measures to control the spread of diseases could include closing businesses, schools, and public transportation.¹⁰² Even without closures, people with the illness or those in fear of contracting the disease may keep residents away from public areas. Redmond's food supply may be in danger of running short as workers in the food industries fall victim to the disease, impeding delivery of food supplies and depriving people of vital nourishment when their immune systems may be in greatest need of it.¹⁰³

The 2003 SARS outbreak was an example of how a new disease outbreak impacts the economy of the infected countries. Originating in China, the previously unknown disease quickly spread internationally to other Asian countries and North America. International air travel was identified as contributing to its spread.¹⁰⁴ Air travel to SARS-infected areas immediately plummeted due to travel advisories. Tourism and other businesses related to international travel were also affected; a decrease in customers visiting local businesses hurt revenue streams. Special isolation hospitals were dedicated in Hong Kong and Singapore to contain SARS patients. SARS was

100 Public Health- Seattle and King County, "General Questions About Pandemic Flu," <http://www.kingcounty.gov/healthservices/health/preparedness/pandemicflu/questions.aspx>.

101 Washington State Department of Health, "Pandemic Influenza Planning Guide for State Agencies," <http://www.doh.wa.gov/panflu/pdf/StateAgencyPanFluGuide.pdf>, 5.

102 U.S. Department of Health and Human Services, "Pandemic Influenza Planning: A Guide for Individuals and Families," (2006). <http://www.pandemicflu.gov/plan/pdf/guide.pdf>.

103 Berks County Pandemic Advisory Council, "How will the next pandemic affect you?" <http://www.co.berks.pa.us/pac/cwp/view.asp?a=3&q=494721&pacNav=%7C34106%7C34108%7C>.

104 World Health Organization, "Communicable Disease Surveillance and Response: Severe Acute Respiratory Syndrome (SARS)," http://www.who.int/csr/media/sars_wha.pdf.

transmitted within hospitals, making isolation necessary.

D. Populations

The H1N1 Influenza outbreak of 2009 in Mexico has seen many more fatalities in adults between the ages of 15-50.¹⁰⁵ Although all populations are vulnerable to an outbreak, populations that have increased exposure to viruses or have compromised immune systems are more likely to be infected.

Hazard Specific

People that are exposed to the infected will be particularly vulnerable. Travelers may be more vulnerable to a disease that suddenly appears internationally. Healthcare providers who are treating the infected will have increased contact with the disease and thus will have heightened exposure.

Isolated Populations

If quarantine measures are taken and transit services are reduced in an effort to prevent or slow down the spread of a disease, some people may have difficulty obtaining or accessing goods and services.

Children

Young children, under the age of five, have delicate immune systems that may make them more vulnerable to contract and survive a disease.¹⁰⁶ School children may be more vulnerable due to increased exposure to large populations and inadequate hand washing. Twenty-five percent of Redmond's population consists of children over the age of three that are attending school.¹⁰⁷

Elderly

People over the age of 65 experience increased risk.¹⁰⁸ Those with existing medical conditions and compromised immune systems are more vulnerable to infection and death. The H1N1 Influenza outbreak of 2009 is an example of a disease that produces only mild symptoms in the majority of people, but may be fatal for those who have asthma, diabetes, or heart disease, illnesses which are common in the elderly.¹⁰⁹ Additionally, like hospitals and schools, the concentration of people in a retirement home increases exposure.

Limited English Language

People who have limited English language skills may have increased difficulty communicating with healthcare providers. This may lead to a delay in diagnosis and treatment. Without prompt identification, the risk of transmission increases and the lack of prompt treatment may cause the case to be more severe. Evidence has shown that current anti-viral drugs may be effective in a pandemic influenza outbreak, but

105 Tara Smith, "Swine flu and deaths in healthy adults--cytokine storm?" Aetiology April 26, 2009, http://scienceblogs.com/aetiology/2009/04/swine_flu_and_deaths_in_health.php.

106 Sam Lister, "Young and Elderly in Danger of Infection," The Times, September 8, 2005, <http://www.timesonline.co.uk/tol/news/world/article564087.ece>.

107 Census, 2000

108 Sam Lister, "Young and Elderly in Danger of Infection," The Times, September 8, 2005, <http://www.timesonline.co.uk/tol/news/world/article564087.ece>.

109 <http://www.nytimes.com/2009/05/09/health/09flu.html>

those drugs must be given at the first signs of the illness.¹¹⁰

Low-Income Residents

Uninsured and underinsured people often delay seeking care until symptoms become severe. Delayed diagnosis can increase transmission and decrease treatment effectiveness.

9.3.3 Analyzing Development Trends

Population growth will increase the number of residents who could potentially be exposed to a pandemic disease. An increase in population density may increase the frequency of contact between infected individuals, thus hastening the spread of disease.

¹¹⁰ <http://www.nytimes.com/2009/05/09/health/09flu.html>

Heat Wave Risk Assessment

This plan is an update of the 2004 City of Redmond Hazard Mitigation Plan (HMP). Although it is an update, this document has been redesigned so that it looks, feels, and reads differently than the original. This is due to several factors: new hazard information has become available that drives new definitions of risk, the City has matured and new capabilities are now available, and the new format will allow readers to more easily understand the content. In addition, the 2004 HMP included several action items that have been completed, creating an opportunity for developing new mitigation strategies.

10.1 Identifying Heat Wave Hazards

A heat wave is commonly defined as a period of abnormal, uncomfortably hot weather. The maximum daytime Heat Index (HI) defines a heat wave by combining temperature with humidity to calculate how hot it feels. Locally, daytime temperatures in the 90s are a problem. Since the Pacific Northwest does not typically experience such extreme temperatures, people do not have air conditioning and bodies are stressed by several days of heat in the 90s or above. Periods that do not cool down at night are particularly harmful. Since the 1970s, an average of three to four deaths occur annually. In 1992, an excessively warm summer was linked to 50-60 deaths.¹¹¹

Heat waves are typically more severe in urban areas with stagnant atmospheric conditions and in areas with high levels of humidity. Heat waves occur every summer in many parts of the United States. Increased high temperatures may also lead to wildfires and drought.

10.2 Profiling Heat Wave Hazard Events

A. Location

In the event of a heat wave, all areas of Redmond will be affected. Redmond's temperate climate and suburban setting are generally not conducive to heat waves. The general lack of residential air conditioning will increase the impacts of irregularly high temperatures.

B. Timing and Duration

Heat waves occur in the summer months and generally can be predicted through weather monitoring. Two consecutive days of temperatures above 90°F triggers the National Weather Service Heat Advisory. Typical hot weather in Redmond is in the low 90°F range and generally lasts for a maximum of four days.¹¹²

¹¹¹ National Weather Service, "Heat Wave: A Major Summer Killer," National Oceanic and Atmospheric Administration (NOAA), http://www.nws.noaa.gov/om/brochures/heat_wave.shtml.

¹¹² Office of the Washington State Climatologist, Temperature data from 1999-2008, Courtesy of Karin Bumbaco. Assistant State Climatologist.

C. Severity

According to temperature data from the Office of the Washington State Climatologist, the average Redmond area temperature is 76°F. The highest summer temperatures in 2000-2008 in the Redmond area are displayed in Figure 7. In 2006 and 2007, Redmond experienced historic highs of 95°F.¹¹³ Redmond's record high temperature is below the National Weather Service's alert temperature of 105°F. However, due to the generally mild climate, several days in the 95°F range would have a significant impact on the City.

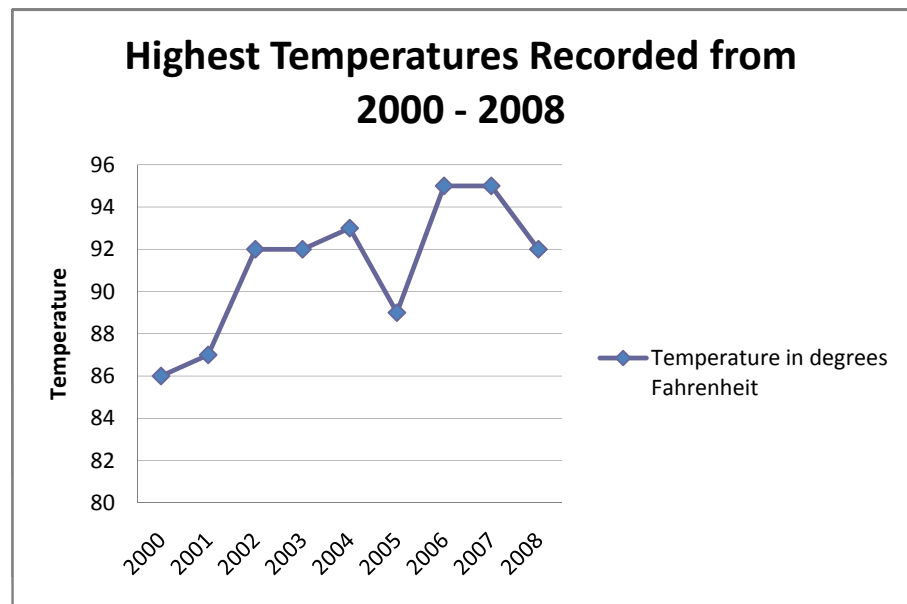


Figure 7: Highest Temperatures Recorded in Redmond Area
Source: Data from the Office of the Washington State Climatologist

D. Frequency

Previous Occurrences

Redmond has never experienced a heat wave as defined by the National Weather Service. However, Redmond has experienced temperatures in the upper 90s that have lasted for several days, in both 1992 and in 2009, with a new record high temperature of 103 degrees.

Probability of Future Events:

Climate change trends will increase the number of hot weather days in Redmond. Predictions indicate that average temperatures will increase 2°F by 2020.¹¹⁴ Temperature fluctuations will be more extreme, potentially increasing temperatures in the Redmond area to higher levels that would trigger a National Weather Service alert. Climate change information also suggests that increasing temperatures will affect urban and rural areas similarly. In the future, Redmond may not be insulated from heat waves as it has been in the past.¹¹⁵

10.3 Assessing Heat Wave Vulnerability

¹¹³ Ibid.

¹¹⁴ Climate Impacts Group, "Climate Change Scenarios," University of Washington, <http://cses.washington.edu/cig/fpt/ccscenarios.shtml#caveats>.

¹¹⁵ Climate Impacts Group, "Climate Change Scenarios," University of Washington, <http://cses.washington.edu/cig/fpt/ccscenarios.shtml#caveats>.

10.3.1 Overview

Currently, extremely high temperatures are rare in the Pacific Northwest and thus Redmond is not particularly vulnerable. However, as the climate changes, heat waves are an anticipated hazard. In the event of a heat wave in Redmond, human populations, the natural environment and energy systems may be affected. Since Redmond is unaccustomed to heat waves, temperatures in the 90s may have impacts, even though such an event would not trigger a National Weather Service alert.

10.3.2 Profiling the Vulnerabilities

A. Man-made

Built structures are not vulnerable to heat waves.

B. Natural

In the event of a heat wave, some crop growth may be impacted if the heat occurs during the plant's early development stages. If a drought accompanies a heat wave, water shortages will impact crop and other vegetation growth. Extreme high temperatures may also increase the likelihood of wildfires. Heat waves can increase temperatures in streams and rivers, which could lead to changes in migration timing, reduce growth rates and reduce available oxygen for local fish species.¹¹⁶

C. Systems

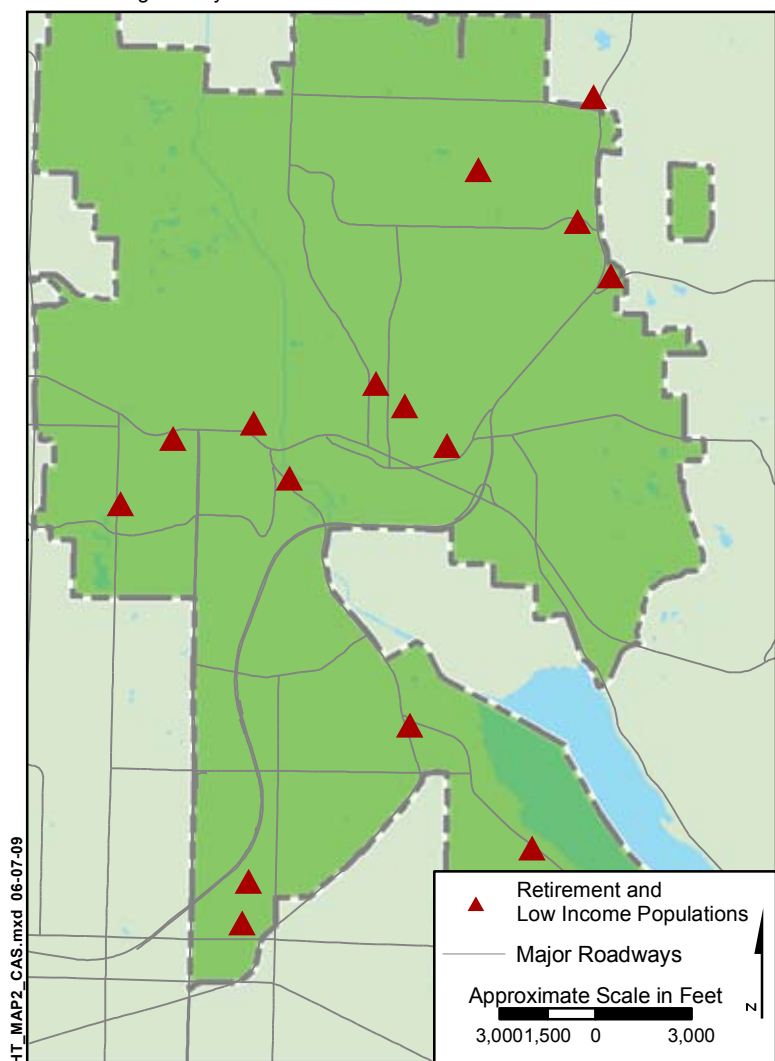
Extremely high temperatures will increase water usage. The water supply is vulnerable to overuse during a heat wave. High temperatures can soften asphalt or buckle concrete. Such damage to the roadways would lead to regional transportation problems.¹¹⁷

D. Populations

The body cannot easily compensate with overexposure to heat. Heat-related illnesses include fatigue, dehydration, heat

Retirement Homes and Low Income Populations

Source: King County



Map 32: Retirement Homes and Low Income Populations

¹¹⁶ National Wildlife Federation, "A Great Wave Rising: Solutions for Columbia and Snake River Salmon in the Age of Global Warming," <http://www.nwf.org/GlobalWarming/pdfs/AGreatWaveRising.pdf>.

¹¹⁷ Cooperative Institute for Research in the Atmosphere, "Impacts of Temperature Extremes," <http://sciencepolicy.colorado.edu/socasp/weather1/adams.html>.

exhaustion and heat stroke. In a normal year, about 175 Americans die from the summer heat.¹¹⁸

Hazard Specific

People without access to cooling devices such as air conditioning may be more vulnerable during a heat wave.

Isolated Populations

Since there will be little structural damage during a heat wave, people will not become isolated.

Disabled Persons

Disabled persons with compromised immune systems may have an increased risk.

Elderly

High temperatures require the human heart to work harder to pump blood toward the skin to help regulate body temperature. Elderly populations, especially those with heart conditions, will be more impacted by heat waves.¹¹⁹

Limited English Language

Non-English speaking populations will not be particularly vulnerable to heat waves.

Low-income Residents

Low-income residents may be more impacted by heat waves if they do not have access to air-conditioning.

10.3.3 Analyzing Development Trends

Development and paved surfaces increase local surface temperatures. Urban areas create localized “heat islands”; increased development in Redmond will amplify this effect. If heat waves are accompanied by water shortages, population increases will correlate to water demand.

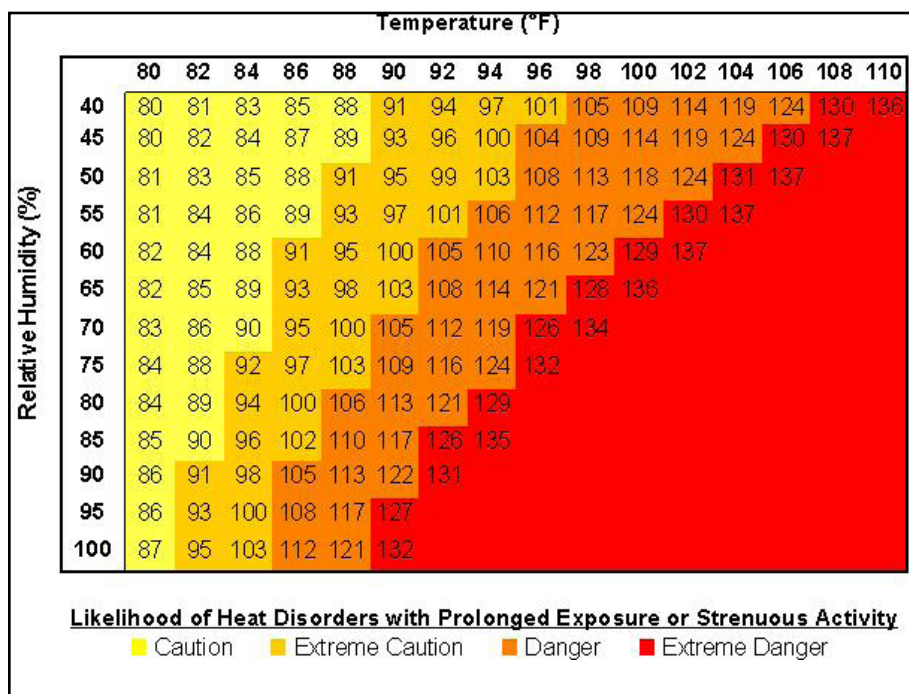


Table 18: Likelihood of Heat Disorders Based on Temperature and Relative Humidity
Source: National Oceanic and Atmospheric Administration, “National Weather Service Heat Index,” <http://www.nws.noaa.gov/om/heat/index.shtml>.

¹¹⁸ National Weather Service, “Heat Wave: A Major Summer Killer,” National Oceanic and Atmospheric Administration (NOAA), http://www.nws.noaa.gov/om/brochures/heat_wave.shtml.

¹¹⁹ Cooperative Institute for Research in the Atmosphere, “Impacts of Temperature Extremes,” <http://sciencepolicy.colorado.edu/socasp/weather1/adams.html>.

Drought Risk Assessment

This plan is an update of the 2004 City of Redmond Hazard Mitigation Plan (HMP). Although it is an update, this document has been redesigned so that it looks, feels, and reads differently than the original. This is due to several factors: new hazard information has become available that drives new definitions of risk, the City has matured and new capabilities are now available, and the new format will allow readers to more easily understand the content. In addition, the 2004 HMP included several action items that have been completed, creating an opportunity for developing new mitigation strategies.

11.1 Identifying Drought Hazards

A drought is an extended period (usually one or more seasons) of abnormally low precipitation. It is a condition of climate dryness severe enough to reduce soil moisture, water and snow levels below the minimum level necessary for sustaining normal plant life, animal life, and economic systems. Droughts are often exacerbated by overuse of the water supply by residents. Secondary effects that may result from drought may include fire, landslides and economic impacts.¹²⁰

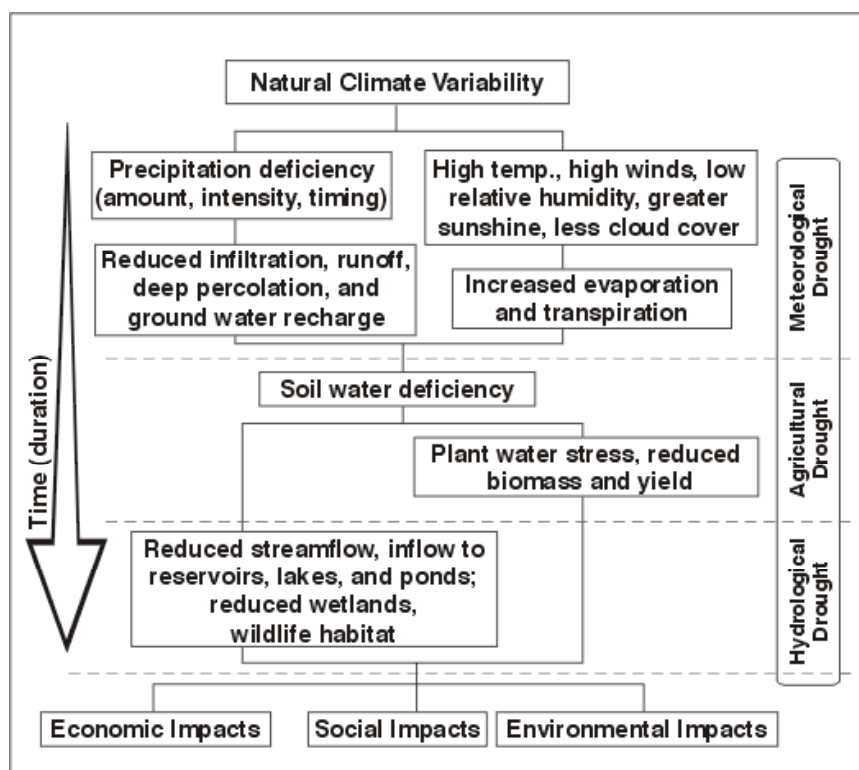


Figure 8: Concept of Drought

Source: National Drought Mitigation Center, "Concept of drought."

In 1989, the Washington State Legislature gave permanent drought relief authority

¹²⁰ National Drought Mitigation Center, "What is Drought," University of Nebraska, Lincoln. <http://drought.unl.edu/whatis/concept.html>.

to the Department of Ecology and enabled them to issue orders declaring drought emergencies (RCW 43.83B.400-430 and Chapter 173-166 WAC). In order to declare a drought in the State of Washington, two characteristics must be met:

- The water supply for the area must be below 75% of normal levels
- Water uses and users in the area must be likely to incur undue hardships because of the water shortage.¹²¹

60% of the water used by Redmond comes from the Cedar and Tolt watersheds, supplied by Seattle Public Utilities (SPU). The watersheds provide potable water to numerous cities in King County. The reservoirs have a limited capacity and therefore, large rain events in the winter do not necessarily prevent summer droughts. The reservoirs must be continually fed by rain and snowmelt to have an adequate supply. Redmond does not have direct control over the amount of water it will be allotted during times of drought and must share a drought's impact among numerous other cities.¹²²

The other 40% of Redmond's water is supplied by five main groundwater wells located in the City.¹²³ The wells are recharged by rain. During a drought that lasts for a short period, Redmond's groundwater supply may incur no significant changes; however, water stored in soil can be rapidly depleted during extended dry periods. Additionally, when drought conditions abate, groundwater takes longer to recover than soil water reserves, stream-flow, reservoirs and lakes.¹²⁴

121 Washington State Legislature, "Revised Code of Washington," <http://apps.leg.wa.gov/RCW/>.

122 Seattle Public Utilities, "Cedar and Tolt Watersheds," City of Seattle, http://www.seattle.gov/util/About_SPU/Water_System/Water_Sources_&_Treatment/index.asp.

123 City of Redmond, "Drinking Water," City of Redmond, http://www.ci.seattle.wa.us/util/About_SPU/Water_System/Water_Supply/SPU01_001850.asp.

124 City of Redmond, "Wellhead Protection," City of Redmond, <http://www.redmond.gov/insidecityhall/publicworks/environment/groundwaterordinance.asp>.

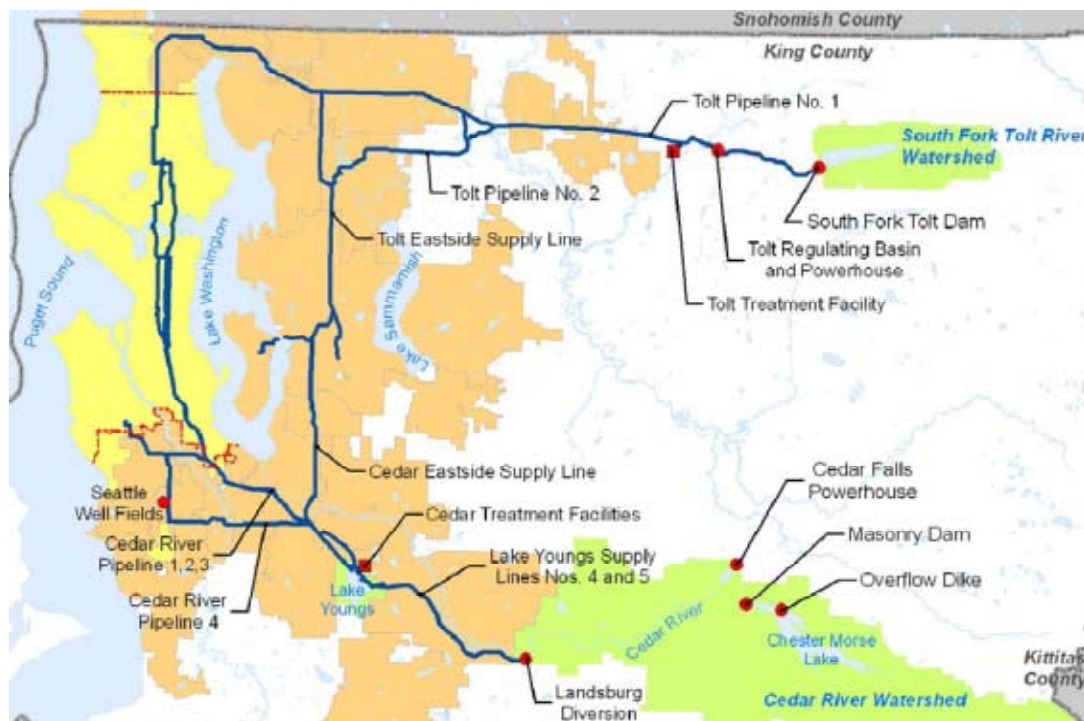


Figure 9: South Fork Tolt Water Management Plan

Source: Seattle Public Utilities, "South Fork Tolt Water Management Plan".

11.2 Profiling Drought Hazard Events

A. Location

Since the whole City of Redmond relies on shared water sources, the entire City will be affected by a drought. Past droughts in the Puget Sound Region have resulted in water use restrictions and higher water charges. Redmond business and residents were consequently unable to adequately maintain landscaping. Water shortages cause loss of vegetation, including the 1,300 acres of parks located in the City.¹²⁵

B. Timing and Duration

A short-term drought lasts anywhere from three to six months while long-term droughts can last for several years.¹²⁶ Given the history of drought in the Puget Sound region, it is likely that any drought that would affect Redmond would only last for a short period, taking place in spring and/or summer months, and would be easily forecast well before it occurred.

C. Severity

Droughts in the Pacific Northwest are likely to: reduce potable water supplies, provide inadequate stream flow volumes to support fish, increase the threat of wildfires, and pose a threat to vegetation that relies on natural precipitation. The severity of a

¹²⁵ City of Redmond, "About Redmond," City of Redmond, <http://www.redmond.gov/aboutredmond/general2.asp>.

¹²⁶ National Drought Mitigation Center, "What is Drought?" University of Nebraska, Lincoln, <http://drought.unl.edu/whatis/concept.hmt>.

drought can be reduced by water conservation technology and practices. The length of the recovery period is determined by the intensity of the drought, duration, and quantity of precipitation received as the drought recedes.¹²⁷

In 2001, Seattle Public Utilities decreased the risks associated with a drought to its users and the salmon runs through designed, monitored, and implemented water conservation tactics.¹²⁸

D. Frequency

Previous Occurrences

Since 1900, about fifteen droughts of various durations have affected the Puget Sound Region, the most recent droughts occurred in 2001 and 2005.¹²⁹

King County Office of Emergency Management lists the most significant droughts affecting the Puget Sound region in the past thirty-five years as:

- **1965-1966:** The entire State was affected by drought conditions from June 1965 to December 1966.
- **June-August 1967:** No rain fell from the third week in June to the third week in September. 1,767 fires burned throughout the State.
- **October 1976-September 1977:** King County experienced precipitation levels 57 percent of normal. Stream flows averaged between 30 and 70 percent of normal. Temperatures were higher than normal, which resulted in algae growth and fish kills.
- **October 1991-September 1994:** Stream flows were between 30 and 60 percent of normal. Agriculture products suffered greatly. Thirty counties were designated as Emergency Drought Impact areas.
- **March of 2001:** The National Weather Service reported that the winter of 2000-01 was the driest since 1976-1977. It was also one of the five driest in the past 100 years.¹³⁰ Following above-average precipitation in the final two months of the year, the drought emergency formally expired on December 31, 2001.

Probability of Future Events

The possibility of drought affecting Redmond is moderate based on historical records. Seattle Public Utilities does provide a document titled “Current Water Supply Conditions and Outlook.” Based on the history of drought in Puget Sound and Washington State there is a risk that some form of drought will affect Redmond at least once each decade, though the impacts may be mild. The frequency, duration and depth may increase with climate change.¹³¹

127 King County Office of Emergency Management, “Natural Hazards: Droughts,” King County, http://www.kingcounty.gov/safety/prepare/residents_business/Hazards_Disasters/Droughts.aspx.

128 Seattle Post Intelligencer, “Seattle Drought Efforts Pay Off,” Seattle Times, http://www.seattlepi.com/local/37701_drought05.shtml.

129 Puget Sound Business Journal, “Drought: Dry weather of 2005 drains reservoirs and ruins orchards,” Puget Sound Business Journal, <http://seattle.bizjournals.com/seattle/stories/2005/08/01/story2.html>

130 King County Office of Emergency Management, “Natural Hazards: Droughts,” King County, http://www.kingcounty.gov/safety/prepare/residents_business/Hazards_Disasters/Droughts.aspx.

131 National Center for Atmospheric Research, “Drought & Wildfire,” <http://www.ncar.ucar.edu/research/climate/drought.php>.

While King County is not on Washington State's list of jurisdictions most vulnerable to drought, nor is it a critical area for drought according to the National Drought Mitigation Center; the historical record of both Western Washington and the State demonstrates that it is important to consider drought conditions as a potential impact to the region. Climate change will change the patterns of precipitation and the expanse of arid regions.¹³² Even without changes in the overall quantity of precipitation, rain replacing snow will cause shortages in the summer water supply.

11.3 Assessing Drought Vulnerability

11.3.1 Overview

Western Washington and Redmond's economy are vulnerable to droughts. Reduced water supply will have an impact on the systems and people that require water. Reduced stream flows will impact wildlife and hydroelectric power. Landscapes, natural habitats, vegetation, and area parks and trails will be vulnerable.¹³³

11.3.2 Profiling the Vulnerability

A. Man-made

Droughts have no significant impact on man-made structures. Lawns, gardens, and other human-manipulated landscapes and vegetation such as golf courses are vulnerable to droughts.

B. Natural

Drought may reduce stream flows, which will impact aquatic life and ecosystems that are dependent on the stream. Low stream flows will increase water temperatures affecting the migration and reproduction habits of salmon and trout.¹³⁴ A drought may also lead to insufficient recharge of aquifers, creating water shortages. Decreased precipitation will increase the likelihood of wildfires, as dry trees and brush have an increased risk of burning.

C. Systems

Reduction of available water in reservoirs intensifies the debate over water allocation among agricultural irrigators, municipal water authorities, environmental agencies, and industrial users. Additionally, water quantity affects the availability and cost of electricity since Puget Sound is heavily reliant on hydroelectric power plants. The water supply and energy supply are vulnerable to a drought.

Drought will impact all populations in Redmond. Specific businesses that require larger portions of water to run their business (carwashes, golf courses, etc.) will be especially vulnerable if they do not have mitigation strategies in place to withstand the

¹³² International Panel on Climate Change and University of Washington Climate Impact Group, "Climate Change Scenarios," University of Washington, <http://cse.washington.edu/cig/fpt/ccscenarios.shtml>.

¹³³ Seattle City Light, "Water Conditions: Rainfall and Snowpack," City of Seattle, <http://www.seattle.gov/light/ctracks.html>.

¹³⁴ Washington Department of Fish and Wildlife, "Drought Planning," <http://www.wdfw.wa.gov/drought/>.

shortage. Additionally, increased electricity charges could place economic hardships on small businesses, and businesses that consume larger amounts of energy.

D. Population

Droughts will impact the entire region. Unless water restrictions are not sufficient to ration enough potable water to meet basic necessities, no specific populations will experience heightened vulnerability. However, the resulting increased electricity and water rates may be and economic hardship for limited income residents.

11.3.3 Analyzing Development Trends

The City of Redmond water system currently serves a residential population of approximately 51,530 and a business community with an estimated 85,775 employees.¹³⁵ Redmond does not have additional water supplies and their water service area is fixed. Future growth in the area will be limited to the water sources and sewer infrastructure currently available. Without conservation efforts, increased population in the area will strain water and sewer resources.

¹³⁵ City of Redmond, "About Redmond," City of Redmond, <http://www.redmond.gov/aboutredmond/general2.asp>.

Hazardous Materials Risk Assessment

This plan is an update of the 2004 City of Redmond Hazard Mitigation Plan (HMP). Although it is an update, this document has been redesigned so that it looks, feels, and reads differently than the original. This is due to several factors: new hazard information has become available that drives new definitions of risk, the City has matured and new capabilities are now available, and the new format will allow readers to more easily understand the content. In addition, the 2004 HMP included several action items that have been completed, creating an opportunity for developing new mitigation strategies.

12.1 Identify Hazardous Materials Hazards

The EPA defines hazardous materials as liquid, solid, contained gas, or sludge wastes that contain properties that are potentially harmful to human health or the environment.¹³⁶ Hazardous materials are typically released in the form of spills, leaks, or vapor emissions. These are known as either a point source release that can be traced back to a single origin, or non-point source releases that occur incrementally, slowly polluting the environment.

Non-point source hazardous materials are difficult to track and control. Facilities that contain large quantities of hazardous materials are regulated to reduce the risk of point source spills. These facilities are categorized as Tier II facilities, which are defined as those that equal or exceed the thresholds of hazardous materials listed under Section 311(e) of Title III of the Superfund Amendments and Reauthorization Act (SARA).¹³⁷

Tier II facilities are required to complete a Tier II Emergency and Hazardous Chemical Inventory report by The Washington State Emergency Response Commission (SERC). These facilities are also required to report to the Local Emergency Planning Committee (LEPC), and local fire department. Tier II storage facilities are required to comply with federal safety requirements and are regulated by the U.S. Environmental Protection Agency.

12.2 Profiling Hazardous Materials Hazard Events

A. Location

Both point source and non-point source pollution is likely to occur where hazardous materials are located. **Map 33, City of Redmond Tier II Hazardous Material Facilities**, shows the location of all facilities that keep significant amounts of chemicals on site. Point source releases are more easily identified. While non-point source pollution can also occur where hazardous materials are present, such releases may not be

¹³⁶ U.S. Environmental Protection Agency, "Wastes—Hazardous Waste," <http://www.epa.gov/osw/hazard/index.htm>.

¹³⁷ Emergency Planning and Community Right-to-Know Act (EPCRA), "Hazardous Chemical Storage Reporting Requirements," U.S. Environmental Protection Agency, http://www.epa.gov/oem/content/epcra/epcra_storage.htm.

immediately recognizable. Both types of releases can occur either on location where the hazardous materials are stored, or along transportation routes.

The Olympic Pipeline is another potential source for a hazardous material spill. Located along the western edge of the City of Redmond, it transfers millions of gallons of jet fuel, gasoline or diesel daily.

B. Timing and Duration

The time component of point source hazardous materials incidents can range from hours to days. Factors contributing to the duration and subsequent severity of hazardous materials events are the ability of local and/or regional transportation agencies, incident response, and toxic chemical handlers to respond to the event. Non-point source hazardous material release occurs slowly over an extended period of time.

C. Severity

According to the U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA), hazardous materials are most dangerous when they are first released from containment, and the severity of an event depends on the chemical and biological components of the material released.¹³⁸ A significant number of Tier II facilities in Redmond hold supplies of sulfuric acid or gasoline/diesel. Sulfuric acid is described as “more hazardous than most chemicals” by 7 out of 10 ranking systems and is one of the most prolific chemicals produced in the United States. However, an extensive web of federal, state, and local regulations effectively limits the probable impacts and severity of a point source hazardous materials incident.

D. Frequency

Previous Occurrences

Sulfuric acid is listed as the second most common Tier II hazardous material in Redmond. There have been no reported point-source releases of the Tier II hazardous material, sulfuric acid, in Redmond (zip codes: 98052, 98053, 98073).¹³⁹ No point-source releases of any Tier II chemicals previously been reported in Redmond. Non-Tier II point-source releases are unknown, and are more difficult to identify due to less stringent regulation than Tier II hazardous materials. Non-point source releases are not monitored, and therefore no records exist of their previous occurrences.

Probability of Future Events

An increase in hazardous material facilities due to the projected growth of the City will increase the potential for both point source and non-point source events.

¹³⁸ U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration. “Incident Reporting.” <http://phmsa.dot.gov/hazmat/incident-report>

¹³⁹ Environmental Defense Fund, “Scorecard, the Pollution Information Site,” <http://www.scorecard.org>.

12.3 Assessing Hazardous Materials Vulnerability

12.3.1 Overview

Although there are numerous sites in Redmond that contain sizable amounts of Tier II hazardous materials, the stringent regulations for handling, storage, transport, and recording of Tier II hazardous materials and related facilities limit the vulnerabilities. However, the presence of toxic chemicals does present a great risk to the human population and the environment.

12.3.2 Profiling the Vulnerabilities

A. Man-made

Buildings are vulnerable to a hazardous materials spill. The combination of fire, water and chemicals could result in an explosion that is likely to damage both the buildings storing hazardous materials and neighboring buildings. Proper storage and handling of these chemicals is critical in decreasing built environment vulnerability.

B. Natural

Factors contributing to the vulnerability of natural systems are the type of chemical spilled, the physical state of the chemical, the amount released, and the location of the incident. Vulnerability of the natural environment to hazardous materials events is higher for species and ecosystems in the immediate vicinity of the event, and moderate for those located downstream. Over time, non-point source hazards may accumulate and pose a threat to the natural environment; however, the lack of data on non-point source hazards makes it difficult to justify a significant vulnerability.

C. Systems

A hazardous materials spill anywhere along Redmond's transportation network will have an immediate impact on travel time and delays. A flammable material that explodes would cause significant damage to the roads and bridges. Similarly, an explosion could destroy power lines.

Municipal water systems and stormwater drainage systems are vulnerable to a toxic spill. Chemicals that reach the water system could limit the supply of potable water. Toxic spills that enter a stormwater drainage system may feed directly into local rivers and lakes or into the groundwater.

D. Populations

Hazard Specific

Populations in close proximity to a spill will be particularly vulnerable.

Isolated Populations

The City of Redmond is particularly vulnerable to isolation in the event of a hazardous material spill occurring on a major arterial roadway connecting to the greater Puget

Sound region. A spill that closes or destroys part of SR 520 would leave much of Redmond isolated from the surrounding region.

Disabled Persons

Mobility impaired persons would be vulnerable to a spill or vapor release that requires immediate evacuation. Similarly, people with hearing or sight impairments may require special notification if the standard announcements are not available.

Children

Young children with developing respiratory systems are especially vulnerable to a chemical vapors.

Elderly

Elderly with mobility impairments or compromised immune systems may suffer greater injuries in the case of a hazardous material release.

Limited English Language

Limited English speakers may not have immediate information about a spill without translation. Additionally, access to appropriate aid may be complicated by language barriers.

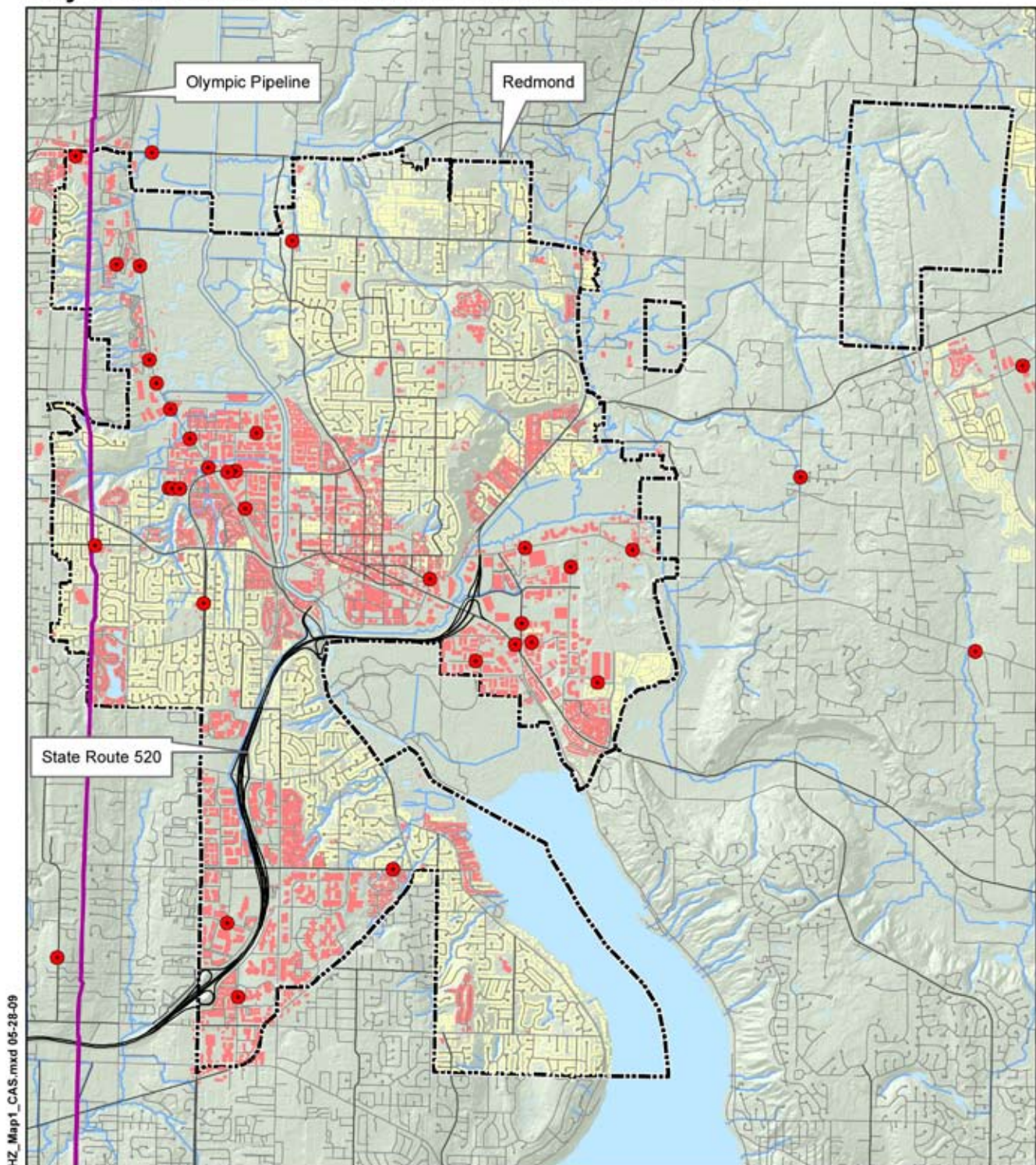
Low-income Residents

Low-income citizens are more likely to reside in closer proximity to hazardous facilities than wealthier counterparts. If displaced by a hazardous materials spill, limited income residents may face additional hardship.

12.3.3 Analyzing Development Trends

A vast majority of existing Tier II facilities are located within industrial and manufacturing areas. The future land use map shows maintenance of similar zoning in areas where the highest concentrations of Tier II facilities are currently located. However, continued automobile dependency may increase the number of gas stations (Tier II facilities) in proximity to residential areas. The addition of wireless telecommunications will increase the number of Tier II facilities near residential areas.

City of Redmond Tier II Hazardous Material Facilities



Sources: State of Washington, King County

- Tier II Hazardous Material
- Commercial Buildings
- Residential Buildings

Approximate Scale in Feet
 5,000 2,500 0 5,000

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13.1 Introduction

This plan is an update of the 2004 City of Redmond Hazard Mitigation Plan (HMP). Although it is an update, this document has been redesigned so that it looks, feels, and reads differently than the original. This is due to several factors: new hazard information has become available that drives new definitions of risk, the City has matured and new capabilities are now available, and the new format will allow readers to more easily understand the content. In addition, the 2004 HMP included several action items that have been completed, creating an opportunity for developing new mitigation strategies.

FEMA requires that a Mitigation Strategy section be included to ensure that the hazard mitigation plan “provides the jurisdiction’s blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.”¹⁴⁰ The 2009 Redmond Hazards Mitigation Plan Update strategies outlined below describe the tools the City will use in order to better mitigate the impacts of hazardous events.

The Project Team created strategies and action items to achieve the hazards mitigation goals of Redmond’s Hazards Mitigation Plan and Comprehensive Plan. The strategies and action items were developed by analyzing the most probable scenarios (See Part 3). The scenarios were chosen in a process that included consultation with Redmond City staff and a prioritization of hazards based on their frequency, severity, and impacts on the natural environment, local systems, the built environment, and vulnerable populations.

Through this process, the Project Team analyzed hundreds of strategies as possible mitigation efforts for the selected scenarios. These strategies were analyzed using input from the public participation meeting, online questionnaire results, and additional meetings with City staff. Consideration of outstanding action items from previous hazards mitigation plans were also considered to create a robust suite of strategies. As part of this narrowing process, a benefit-cost analysis was completed on every action item. Through this analysis, strategies and action items were chosen to best reflect the hazards mitigation needs and opportunities for the City. The action items, including responsible departments and potential financing mechanisms, are provided in detail below.

Mitigation Strategy FEMA Requirements

Requirement §201.6(c)(3): (c) Plan content. The plan shall include the following: (3) A mitigation strategy that provides the jurisdiction’s blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools. This section shall include:

- (i) A description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.
- (ii) A section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.
- (iii) An action plan describing how the actions identified in paragraph (c)(2) (ii) of this section will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

¹⁴⁰ Title 44 §201.6(c)(3), of the Code of Federal Regulations, Chapter 1 Federal Emergency Management Agency, Department of Homeland Security, Part 201 Mitigation Planning, <http://frwebgate.access.gpo.gov/cgi-bin/get-cfr.cgi>.

13.2 Goals

The goals provided by the Redmond Comprehensive Plan and previous Hazards Mitigation Plan were used to determine the overarching hazard mitigation goals for the 2009 update. The goals, listed below, emphasize protection of the environment, the importance of parks and public facilities, resilient transportation options, and a focus on the importance of the Downtown and Overlake areas. With this in mind, strategies that supported these community desires were weighted more heavily in the selection process. In many cases, a natural overlap existed. For example, having multimodal transportation options contributes to the Comprehensive Plan's desired high quality of life as well as providing important redundancy in the face of hazards risk.

The Redmond Comprehensive Plan goals

1. To conserve agricultural lands and rural areas, and to protect and enhance the quality of the natural environment.
2. To retain and enhance Redmond's distinctive character and high quality of life, including an abundance of parks, open space, good schools and recreational facilities.
3. To emphasize choices in housing, transportation, stores and services.
4. To support vibrant concentrations of retail, office, service, residential, and recreational activity in Downtown and Overlake.
5. To maintain a strong and diverse economy and to provide a business climate that retains and attracts locally owned companies as well as internationally recognized corporations.
6. To promote a variety of community gathering places and diverse cultural opportunities.
7. To provide convenient, safe and environmentally-friendly transportation connections within Redmond, and between Redmond and other communities for people and goods.
8. To remain a community of good neighbors, working together and with others in the region to implement a common vision for Redmond's future.

The 2004 Hazards Mitigation Plan outlines the following goals

1. Increase community resiliency to large scale regional events (including local government infrastructure, critical facilities, and lifelines)
2. Reduce vulnerability of single-family homes
3. Reduce vulnerability of small businesses
4. Reduce vulnerability of large corporations
5. Reduce potential for isolation-disrupted lifelines and infrastructure
6. Reduce exposure to high-risk facilities and utilities (including local government infrastructure, critical facilities, and lifelines)
7. Preserve and enhance the natural environment
8. Reduce vulnerability of historic and cultural resources
9. Create recovery plan for Redmond historic district

2004 Goals, Objectives, and Action Items		Status	Notes
Goal 1	Increase Community Resiliency to Large-Scale Regional Events	Ongoing	
Objective 1	Develop alternative emergency government operations capabilities outside of high-risk areas.	Ongoing	
1.1	Decentralize local government operations	Ongoing	Action item 2-2 in 2009 Update.
1.2	Consider stringent retrofits and protective measures if relocation is not feasible, to ensure that its essential facilities are resilient to multiple types of hazards.	Ongoing	Action items 3-1, 3-2, and 3-3 in 2009 Update.
1.3	Construct an alternative EOC (Emergency Operations Center) outside of the known hazard zone	Ongoing	Action item 2-1 in 2009 Update.
Objective 2	Strengthen the local emergency response system to limit the need for, and reliance upon mutual aid agreements and outside assistance during the initial stages of a disaster.	Ongoing	
2.1	Identify "weak spots" in the City's emergency response system within the context of mutual aid dependencies. Prioritize these weaknesses and make plans for strengthening them through local initiatives.	Ongoing	
2.2	Work with neighboring cities and the county in updating the existing Emergency Response Plan to include guidelines for dealing with inadequate resources/personnel during the initial stages of a disaster.	Complete	
Objective 3	Make full use of current technologies in the development of goal to create safer, more resilient communities.	Ongoing	
3.1	Enhance the City's ability to identify and understand the hazards they face by investing in the development of computer technologies.	Complete	
3.2	Enhance the City's existing "Disaster Preparedness" website to include a real-time disaster information center to provide important information to, and communicate with, the public during all stages of a disaster.	Ongoing	
Objective 4	Support a region-based focus on mitigation and sustainability through working with neighboring cities and the county in strengthening public education and outreach programs.	Complete	
4.1	Increase public awareness and preparedness by developing a series of regionally available public workshops or seminars to educate homeowners and local businesses on earthquake-resilient practices.	Ongoing	
4.2	Increase community recovery capabilities by creating a system whereby local residents and businesses can immediately submit damage information to responders and the proper authorities.	Ongoing	
Objective 5	Identify and protect critical facilities in the City of Redmond	No Change	
5.1	Re-evaluate the risks and demands to critical facilities in light of a regional event to facilitate prioritizing structural and non-structural retrofits based on vulnerability.	Ongoing	Action item 3-2 in 2009 Update.
5.2	Continue hazards mapping efforts and distribute data to local officials, as it develops to enhance incorporation of mitigation into Land Use Planning.	Ongoing	
5.3	Review hazard zones and critical areas in Washington (i.e., wetlands, aquifer recharge areas for potable water, fish and wildlife habitat conservation areas, frequently flooded areas, geologically hazardous areas) and develop draft legislation to restrict building of critical facilities in these areas.	Complete	
5.4	Develop infrastructure development policies that will limit the placement of critical infrastructure facilities in hazard-prone areas or served by vulnerable lifelines.	Ongoing	Action items 2-2 and 2-3 in 2009 Update.
Objective 6	Support regional efforts to provide financial incentives to encourage local business owners and residents to conduct seismic upgrades in their facilities.	No Change	
6.1	Provide incentives to policyholders to undertake structural and non-structural seismic retrofits.	No Change	

Table 19: Status of 2004 Goals, Objectives, and Action Items (continued on next page)

2004 Goals, Objectives, and Action Items		Status	Notes
6.2	Encourage lending institutions to provide low-interest mitigation loans for businesses and homeowners.	No Change	
6.3	Allow homeowners to apply a portion of their property tax to retrofit their residence.	No Change	
Goal 2	Reduce Vulnerability of Single-Family Homes and Home-Based Businesses to a Variety of Hazards	Ongoing	
Objective 1	To reduce the vulnerability of single-family homes in high risk neighborhoods to a variety of hazards	Ongoing	
1.1	Implement neighborhood-based risk reduction programs	Ongoing	Action item 1-1 in 2009 Update.
Objective 2	To reduce the vulnerability of single-family homes located on, above, or below steep slopes to damage from landslides.	Ongoing	
2.1	Restore stability of degraded slopes through re-vegetation and slope stabilization efforts.	Ongoing	
Objective 3	To reduce the vulnerability of single-family homes located in flood hazard areas to damage from isolated flooding.	Ongoing	
3.1	The city will apply the new International Building Codes requiring flood-proofed homes in the floodplain and regulations specifying no-fill floodplain, zero-rise floodway analysis, and vegetation retention standards throughout Bear Creek. These regulations will be expanded and applied in all flood-prone areas of Redmond.	Complete	
Objective 4	Increase safety and disaster resilience in Redmond communities by training local residents to be self-sufficient for the initial 72 hours of a disaster.	Ongoing	
4.1	Develop partnerships with FEMA and local organizations to promote disaster preparedness and emergency planning strategies.	Ongoing	Action items 1-1 and 1-4 in 2009 Update.
4.2	Supplement communities' response capability after a disaster by recruiting civilians to be trained as neighborhood, business, and government teams that, in essence, will be auxiliary responders.	Ongoing	Action item 1-1 in 2009 Update.
Objective 5	Develop Community Disaster Preparedness Plans tailored to each specific Redmond community, promoting citizen and small business involvement to encourage a locally driven, community-based effort.	Ongoing	
5.1	Develop partnerships with FEMA and local organizations to promote disaster preparedness and emergency planning strategies.	Ongoing	Action items 1-1 and 1-4 in 2009 Update.
5.2	Establish a Local Steering Committee to assist in the development of the program. The committee could hold monthly meetings to monitor the progress of individual neighborhoods, identify shortcomings, and determine future goals.	No Change	
Goal 3	Reduce Vulnerability of Small Businesses	Ongoing	
Objective 1	To ensure survivability and expedite business resumption following a disaster	Ongoing	
1.1	Design events to promote business continuity	Ongoing	Action item 5-1 in 2009 Update.
1.2	Facilitate partnerships and sharing of resources between small businesses and large corporations (refer to Vulnerability of Corporations, action item 1.4)	Ongoing	Action item 5-2 in 2009 Update.
Objective 2	To encourage small businesses to reduce their vulnerability to a potentially disastrous event	Ongoing	
2.1	Provide incentives for property owners to retrofit un-reinforced masonry buildings and buildings on soft soils that are not tied to their foundations in hazard areas.	No Change	
2.2	Train business owners to properly secure all non-structural items that could be a hazard through non-structural retrofit training.	No Change	
2.3	Host forums for small businesses on mitigation and preparedness practices.	No Change	
Goal 4	Reduce Vulnerability of Large Corporations	Ongoing	
Objective 1	To facilitate partnerships between large corporations and local small businesses	Ongoing	

Table 19: Status of 2004 Goals, Objectives, and Action Items (continued on next page)

2004 Goals, Objectives, and Action Items		Status	Notes
1.1	Use hazard scenarios and involve the business community in risk assessment. Conduct an economic impact analysis. The analysis will act as a springboard for action.	Ongoing	
1.2	Develop a Project Impact-style program that focuses on raising citywide public awareness of business Mitigation Planning.	No Change	
1.3	Partner with the Redmond Chamber of Commerce and the Small Business Administration to plan and develop a Business Resource Center.	No Change	
1.4	Encourage large corporations to include their small business vendors and tenant businesses in their emergency management planning.	Ongoing	Action item 5-2 in 2009 Update.
1.5	Facilitate cooperative agreements between large corporations and local small businesses in a recovery scenario.	Ongoing	Action item 5-2 in 2009 Update.
Goal 5 Reduce Isolation Resulting From Disruption to Lifelines and Infrastructure		Ongoing	
Objective 1	To reduce the disruption to transportation infrastructure from hazard events, Redmond should reduce the vulnerability of transportation infrastructure to hazard events.	Complete	Routes hardened within Redmond. City staff is on three regional committees.
1.1	Cooperate with neighboring jurisdictions and planning and transportation agencies to harden vulnerabilities of transportation routes. Regional planning should reduce transportation disruption between jurisdictions. The inter-connection of businesses and transportation networks in this region amplifies the effects of disruption of goods and commuters across the region. Adjacent jurisdictions, the county, and the state must coordinate prevention and response to transportation disruption from hazard events on all scales.	Ongoing	
1.2	Reduce vulnerability of key transportation routes within Redmond to natural hazard events. The key transportation routes that may be vulnerable to flooding and landslides include portions of Redmond-Woodinville Road, Avondale Road, Redmond-Fall City Road, Union Hill Road, Sahalee Way, East Lake Sammamish Parkway N.E., and West Lake Sammamish Parkway N.E.	Ongoing	
1.3	Perform seismic upgrades of bridges and roadways.	Ongoing	
1.4	Increase travel route redundancy.	Ongoing	
1.5	Support transit systems through transportation improvements.	Ongoing	
Objective 2	To minimize utility service disruption from hazard events, the City of Redmond should reduce the vulnerability of utility production and distribution systems.	Ongoing	
2.1	Reduce the vulnerability of utility infrastructure, hubs and distributions systems.	Ongoing	Action item 3-2 in 2009 Update.
2.2	Ensure adequate function of citywide Tolt water distribution.	Ongoing	
2.3	Preserve the open and uncontaminated state of key aquifer recharge areas.	Ongoing	
2.4	Assess the vulnerability of the electricity transmission center.	No Change	
2.5	Reduce the vulnerability of wire-dependent utility systems.	Ongoing	
2.6	Identify and mitigate points of vulnerability for sewer infrastructure.	Ongoing	
2.7	Prepare for adequate waste storage and management in response to a hazard event.	Ongoing	
Objective 3	Ensure adequate public sector, inter-jurisdictional, and private sector response capability to overall infrastructure disruption.	Ongoing	
3.1	Ensure public sector response capability.	Ongoing	
3.2	Develop response strategies based on route priorities.	Ongoing	Action items 4-2 and 4-3 in 2009 Update.
3.3	Strengthen private sector role in response capability.	Ongoing	
Goal 6 Reduce Hazards Presented By High-Risk Utilities and Facilities		Ongoing	

Table 19: Status of 2004 Goals, Objectives, and Action Items (continued on next page)

2004 Goals, Objectives, and Action Items		Status	Notes
Objective 1	To reduce the risk posed by high-risk utilities and facilities and address the vulnerability of these systems.	Complete	No other politically acceptable options at this time.
1.1	Reduce the risk surrounding an Olympic Pipeline rupture.	No Change	
1.2	Reduce the vulnerability of high-risk utility and facility infrastructure to hazard events in order to reduce the risk to life and property of Redmond's residents and businesses.	No Change	
1.3	Ensure adequate response capability	No Change	
1.4	Educate neighboring residents about hazard and associated risks.	Ongoing	
Goal 7	Preserve and Enhance the Natural Environment	Ongoing	
Objective 1	To protect the future quality of life and environment for its residents, the City of Redmond should reduce vulnerability to changing hazard regimes.	Ongoing	
1.1	Restore natural drainage capacity and structure of streams and wetlands to address future changes in flows.	Complete	
1.2	Identify areas of opportunity for stream and floodplain restoration following hazard events.	Complete	
1.3	Identify areas of opportunity for storm water retrofitting to maximize drainage infrastructure.	Complete	
1.4	Target landslide-prone areas for pre- or post-event restoration and acquisition.	Ongoing	
1.5	Pursue public land acquisition strategies and landscape-level habitat coordination efforts.	Ongoing	
Goal 8	Reduce Vulnerability of Historic and Cultural Resources	Ongoing	
Objective 1	Retrofit designated historic landmarks.	Ongoing	
1.1	Create an inventory of un-reinforced masonry and wood-frame historic landmarks.	Ongoing	Action item 3-2 in 2009 Update.
1.2	Develop incentives to encourage retrofitting.	Ongoing	
1.3	Use hazard scenarios and involve the community in risk assessment. Conduct an economic impact analysis. The analysis will act as a springboard for action.	Complete	
1.4	Create venues to encourage community participation in retrofitting.	Ongoing	
1.5	Integrate Hazard Mitigation Planning into other future planning and program efforts such as the Washington State Downtown Revitalization - Main Street Program.	Ongoing	Action item 2-3 in 2009 Update.
1.6	Enter into an Interlocal Agreement with King County.	Complete	
1.6a	1.6a. Pursue funding for retrofitting from King County. (This action item is contingent upon item 1.6.)	Ongoing	
1.7	Ensure that historic landmarks located in Redmond's 100-year floodplain participate in the National Flood Insurance Program and pursue funding from the Flood Mitigation Assistance Program for mitigation projects.	Complete	
Goal 9	Create a Long-Range Recovery Plan for Redmond's Old Town District	Ongoing	
Objective 1	Ensure recovery planning efforts are consistent with Redmond's values and long-term vision for the Old Town district.	No Change	
1.1	Develop a post-disaster recovery plan as a sub-element of the Comprehensive Plan and the Mitigation Plan for how Old Town will rebuild following a major event, seeking agreement on process and priorities before the event.	Ongoing	
1.2	Form a task force to develop the plan, assign a lead agency and public official, and identify all stakeholders to provide adequate consideration of all relevant issues.	Ongoing	
Objective 2	Plan proactively to take advantage of post-disaster funding opportunities	Ongoing	
2.1	Identify resources, timing, and priorities for funding and technical assistance. Develop justification for items and criteria rationale.	Ongoing	

Table 19: Status of 2004 Goals, Objectives, and Action Items (continued on next page)

2004 Goals, Objectives, and Action Items		Status	Notes
Objective 3	Ensure short-term recovery process and related decisions will implement long-term reconstruction goals in the City Center.	Ongoing	
3.1	Adopt an interim development moratorium so recovery plan alternatives can be considered, while streamlining repair permits and exempting needs for public health and safety provisions.	Ongoing	
3.2	Identify potential properties or sites in or near downtown for temporary housing, business resumption, and debris recycling/dumping, with the awareness that they could remain in place for longer than originally planned.	Ongoing	
Objective 4	Seize opportunities for ecological and urban design improvements for Old Town.	Ongoing	
4.1	Assess need and consider integrating "Green Infrastructure" design solutions to detain, filter, and/or cool surface runoff in developed areas upstream from the Sammamish River.	Ongoing	
4.2	Ensure Recovery Plan is consistent with community and stakeholder desires for the use of the Burlington ROW land, balancing recovery needs and long-term vision. Competing land use needs should be reviewed post-disaster to ensure priorities are met.	Ongoing	
Objective 5	Support business recovery with Main Street Vision and urban design improvements.	Ongoing	
5.1	Preserve building height limits and any strategic open space by employing existing "Transfer of Development Rights" regulations to shift the density where it best serves the needs of the community, natural resources, and transportation efficiency.	Ongoing	
5.2	Actively pursue the vision of Old Town as Redmond's Main Street be encouraging pedestrian uses, character, and activity, and develop specific urban design improvements.	Ongoing	
5.3	Evaluate the relocating of public employees to generate more daytime population and/or investigate an anchor tenant, such as a cinema, to stimulate nighttime activity.	Ongoing	

Table 19: Status of 2004 Goals, Objectives, and Action Items

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13.3 2009 Strategies

Combining the Redmond Comprehensive Plan Goals and unattained goals from the 2004 Hazards Mitigation Plan, we have designed the following strategies for Redmond's 2009 Hazards Mitigation Plan update. This plan recognizes that hazard events are unavoidable. Given the distribution of vulnerabilities across the City and the potential magnitude of events, parts of Redmond will be isolated. Therefore, the strategies outlined in this section are intended to simultaneously increase the self-sufficiency of Redmond's residents and strengthen City resiliency to minimize the duration of that isolation. The strategies are as follows:

Strategy 1

To mitigate impacts involved with isolation following a severe hazard event, Redmond will develop outreach activities to enable Redmond residents, businesses and visitors to survive in-place for more than three days.

Strategy 2

To ensure provision of vital services following a hazard event, Redmond will develop alternative service centers in less hazardous areas.

Strategy 3

To mitigate damage to vulnerable structures and infrastructure, Redmond will promote retrofitting with safe-to-fail mechanisms.

Strategy 4

To mitigate against the loss of major transportation facilities in and around the City, Redmond will invest resources in building more resilient transportation networks.

Strategy 5

To mitigate against the functional loss of business communities, Redmond will develop and deliver business outreach programs.

Strategy 6

To mitigate impacts from expected increases in incidences of shallow flooding, Redmond will build a flood tolerant community able to accommodate increases in low impact flooding

These strategies and the action items necessary for their implementation, along with the methodology by which they were derived, are discussed in detail in the next section.

13.4 Benefit-Cost Analysis

After identifying strategies, the Project Team completed a benefit-cost analysis approximating the costs and benefits associated with each action item. The criterion used to evaluate each item was based on a classification of high, medium, or low for benefit and cost. This process provided financial analysis that contributed to the decision of which action items to include in the final plan.

To approximate benefit, the savings in future expected damage considered the following:

- Frequency of the hazardous event
- Longevity of the benefit
- Discounted present value of future benefits¹⁴¹

Per FEMA requirements, the estimation of benefits did not include the value of human lives or cultural values. However, these items were considered when selecting final action items to include in the plan.

To approximate benefit:

1. **Low** = Less than 1 million dollars in damage prevented
2. **Medium** = Between 1 and 10 million dollars of damage prevented
3. **High** = More than 10 million dollars of damage prevented

To approximate cost:

1. **Low** = Within Redmond's existing budget
2. **Medium** = Less than 1 million dollars in additional funds required
3. **High** = More than 1 million dollars in additional funds required

Action items that provided a Medium or High net benefit and supported the strategies were favored for inclusion in the plan. Items were then reevaluated considering non-monetary values such as health and safety, human lives saved, cultural values, and political feasibility to determine the final list.

See Appendix B for the results of the full benefit-cost analysis. Appendix B is divided into four sections: action items included in the plan, action items that address hazards currently regulated or monitored by external agencies, action items that

¹⁴¹ A seven percent (7%) discount rate was used on future value for this benefit-cost analysis. This is consistent with FEMA's requirement, (Appendix C: DMA 2000 Job Aid C.3 ESMP ii. §201.5[b][2]) to use values in accordance with the Office of Management of Budget (OMB) Circular A-94, <http://www.whitehouse.gov/omb/circulars/a094/a094.html#8>.

regard emerging hazards that may be more appropriate in the next HMP update, and action items that were discarded for one or more reasons (e.g. not financially viable).

13.5 Selected Strategies and Action Items

Strategy 1

To mitigate impacts involved with isolation following a severe hazard event, Redmond will develop outreach activities to enable Redmond residents, businesses and visitors to survive in-place for more than three days.

Hazards Addressed by this Strategy								
Severe Storms	Earthquakes	Floods	Wildfires	Landslides	Pandemics	Heat Waves	Drought	Hazardous Materials
x	x	x	x	x	x	x	x	x

Risks Addressed by Strategy 1

There are ten neighborhoods in Redmond. Three sets of neighborhoods are located on distinct hills, or are separated by the alluvial, liquefiable Bear Creek and Sammamish River valley floors. The remaining area is located on the flat river valley. Severe winter storms limit access to hill communities (see Chapter 4 and **Map 2** for specific locations). Flooding events would make traversing the valley floor difficult.

A Crustal Earthquake along the South Whidbey Island Fault to the north or the Seattle Fault to the south will interrupt accessibility. There will be damage to both access roads crossing the valleys and major arterials servicing Redmond as a whole. Either of these hazard events will isolate residential and business communities for many days.

Hill communities include:

- Education Hill and North Redmond (Residential)
- Overlake, Willows and Grasslawn (Mixed uses within Overlake Community)
- Southeast Redmond (higher neighborhoods) (Mixed uses)

Valley floor communities include:

- Sammamish Valley (Mixed use)
- Downtown (Mixed use)
- Bear Creek (Mixed use)
- Southeast Redmond (lower neighborhoods) (Mixed use)

The Redmond Comprehensive Plan includes a goal to emphasize choices in housing and transportation. The geographic variety creates a context in which subpopulations are at risk of short-term isolation during a major hazard event. Many people can manage this type of isolation with only minor enhancements to current supplies and

preparations.

The City of Redmond will support opportunities that prepare individuals and communities for isolation through the development or enhancement of outreach activities that build upon existing mutual aid systems. Outreach efforts should leverage information technologies, such as the City's website, and direct contact through community organizations, such as schools, businesses, and faith communities. Some educational materials should be community specific. The City should provide information on the following topics in several of the most commonly spoken languages:

- Locating and shutting off home and business utility services
- Testing for contamination of private well water
- Installation of sump pumps or other flood mitigation technologies
- Proper storage of home hazardous materials
- Designated channels and alternative techniques for emergency communications
- Building material upgrades for withstanding extreme weather and other hazard conditions

Further in line with Redmond's desire to afford all residents housing choices, the Community Emergency Response Teams (CERT), Map Your Neighborhood programs and Block Watch should be expanded with a focus on serving neighborhoods with vulnerable populations.

The Redmond Comprehensive Plan also includes goals to create a community of supportive good neighbors while promoting a variety of gathering places and cultural opportunities. It is likely that subpopulations will find themselves isolated from the general public immediately after an event. A properly implemented response plan can provide a small community with the resources necessary to manage being cut off from the rest of the City.

A primary aspect of this strategy is also the identification of potential safe locations, such as parks, open spaces, schools, homes, or faith communities that are accessible by foot and capable of providing basic necessities. Along with stocking safe locations with resources for human needs – food, water, first aid, and medical facilities – these locations should have, or be fitted with, kitchen facilities and emergency power generating equipment. Multiple routes to designated areas should be established with clear, easily understood signage. Finally, as Redmond moves forward with new planning and development, it should encourage mixed-uses as much as possible. Neighborhoods that provide a variety of services will be able to better accommodate residents in the case of extended temporary isolation.

	Action Items	Lead Agencies	Other Agencies/ Partners	Funding
1-1	Develop an enhanced neighborhood based outreach program to better prepare visitors, residents and business owners to be isolated from expected services for extended periods (over 3 days). Program will be built on three successful programs. Map-your-neighborhood Block Watch CERT	Emergency Management	Fire Department Police Department Faith based partners	Redmond Operating Budget
1-2	Initiate a discussion of amending Comprehensive Plan to allow mixed uses within communities that may be isolated	Planning Department	Emergency Management	Redmond Operating Budget
1-3	Identify communities that would be isolated during a probable event, their available private and public services and existing mutual aid systems.	Planning Department		Redmond Operating Budget
1-4	Work with community to identify, implement and promote safe locations that will stock basic human needs.	Emergency Management	King County Public Health, School District, Houses of Worship , Community Groups	Redmond Operating Budget
1-5	Identify and create parks trail and open spaces for meeting places following hazards events.	Parks and Recreation	Emergency Management, School District	Redmond Operating Budget

Table 20: Action Items for Strategy 1

Strategy 2

To ensure provision of vital services following a hazard event, Redmond will develop alternative service centers in less hazardous areas.

Hazards Addressed by this Strategy								
Severe Storms	Earthquakes	Floods	Wildfires	Landslides	Pandemics	Heat Waves	Drought	Hazardous Materials
x	x	x	x	x	x	x	x	x

Risks Addressed by Strategy 2

The Redmond built environment includes three hill communities (see neighborhood listing above) and several built on the valley floor. While each community is threatened by different risks, the varied topography and neighborhood characteristics provide resiliency opportunities.

The Overlake neighborhood is a mixed-use neighborhood located on the southern side of the City, furthest from the South Whidbey Island fault. It is located on soils less vulnerable to ground shaking, off the floodplain. The neighborhood has the greatest exposure to a Seattle Fault event.

The **Education Hill** neighborhood is located to the north of Downtown closer to the South Whidbey Island Fault escarpments, but farther from the Seattle Fault. It is also off the floodplain. The City of Redmond is currently designing Fire Station 17; the location of this station is outside of the liquefaction zone for a quake along the Seattle Fault. An alternate emergency operation and command center has been proposed for Station 17 to harden the City's response capabilities in the event of a Seattle Fault earthquake.

The valley communities (including the neighborhoods of **Sammamish Valley, Downtown, Southeast Redmond** and **Bear Creek**) are relatively equally vulnerable to earthquake events along either fault. These communities are also vulnerable to severe flooding. Despite the liquefaction and flooding threats, the large, flat valley topography has remained accessible during historical heavy snow conditions and following Benioff earthquakes with distant epicenters. There are many services available in the valley communities. The majority of Redmond's commercial and retail establishments, City Hall, a major community center, Fire and Police headquarters are located within these neighborhoods.

The Redmond Comprehensive Plan includes a goal to support the vitality of both the Downtown and Overlake areas through concentrations of business, residential, and recreational activities in both areas. Aligned with this idea of multiple community cores, this strategy envisions locating redundant, vital City services in two or three of the following distinct areas of the City:

- Overlake commercial area
- Education Hill – Fire Station 17
- Downtown Emergency Operation Center (EOC)

The current placement of first responders and City operations centers within earthquake liquefaction areas and flood hazards zone will restrict capabilities under probable scenarios. A large-scale earthquake that causes severe damage to business and residential interests throughout Redmond could also completely disable existing emergency response and recovery capabilities. Alternative capabilities do not currently exist.

	Action Items	Lead Agencies	Other Agencies/ Partners	Funding
2-1	Develop alternative redundant services off floodprone, liquefiable lands.	Planning Department	Public Works Emergency Management Fire Department	Redmond Operating Budget Funds will have to be sought to develop Fire Station 17 and an Overlake facility.
2-2	Until alternative sites can be developed, continue partnership with Microsoft. Develop new City command center(s) away from downtown liquefaction and flood zones.	Emergency Management	Public Works, Fire Department, Police Department, Microsoft	GMA fund requests via Comprehensive Plan Updates
2-3	Integrate the HMP goal of creating decentralized centers into the comprehensive plan to provide further support for existing policies supporting multiple centers and consider hazards in general planning decisions	Planning Department		Redmond Operating Budget

Table 21: Action Items for Strategy 2

Strategy 3

To mitigate damage to vulnerable structures and infrastructure, Redmond will promote retrofitting with safe-to-fail mechanisms.

Hazards Addressed by this Strategy

Severe Storms	Earthquakes	Floods	Wildfires	Landslides	Pandemics	Heat Waves	Drought	Hazardous Materials
x	x	x		x				

Risks Addressed by Strategy 3

The Redmond built environment is among the newest of the Seattle metropolitan communities. Most infrastructure and buildings were built in compliance to rigorous earthquake and national flood insurance codes and ordinances with the exception of:

- Unreinforced Buildings
- Homes built before 1970 that predate the International Building Code earthquake and National Flood Insurance regulations

Securing utility lines and facilities to avoid secondary hazards such as power outages or fire is an important aspect of mitigating hazard damage. Retrofitting structures and equipment can be a cost effective way to mitigate damage to the built environment.

	Action Items	Lead Agencies	Other Agencies/ Partners	Funding
3-1	Provide incentives for seismic retrofitting of historic buildings, including tax credits, low interest revolving loans, code compliance, grants, and/or municipal bonds.	Planning Department	Public Works Emergency Management	Grants, Loans, National Register, Community Development Block Grant
3-2	Create an inventory of susceptible buildings, culverts, roads and other critical utilities. Use inventory to prioritize retrofits of City assets.	Public Works	Puget Sound Energy	Puget Sound Energy
3-3	Locate emergency response and operation centers north, in Fire Station 17 and south of Downtown in the Overlake neighborhood. Once appropriate facilities have been determined they should be retrofitted, if necessary, to withstand severe ground shaking.	Planning Department	Emergency Management	FEMA Grants

Table 22: Action Items for Strategy 3

Strategy 4

To mitigate against the loss of major transportation facilities in and around the City, Redmond will invest resources in building more resilient transportation networks.

Hazards Addressed by this Strategy								
Severe Storms	Earthquakes	Floods	Wildfires	Landslides	Pandemics	Heat Waves	Drought	Hazardous Materials
x	x	x	x	x				x

Risks Addressed by Strategy 4

The loss of functional transportation systems cannot be avoided in the scenarios driving this Mitigation Plan. Due to this, it is important that the City reinforce connections to service centers with hardened infrastructure and alternate multi-modal routes.

Connections between service centers under consideration include:

- Southern Center -- Overlake neighborhood
- Central Center -- City Hall and City ECC
- Northern Center -- Fire Station 17

Establishing an emergency conditions roadway management plan would mitigate the impacts of hazards to current roadways. Providing these hardened and alternative transportation facilities will provide better access to and from emergency service centers. This is particularly important given the absence of major medical facilities within City limits.

Another key part of this strategy is the provision of a comprehensive non-motorized trail network that can facilitate travel when traditional roads are not usable. This relates closely with Comprehensive Plan goals pertaining to open space and recreational opportunities, as well as Hazards Mitigation Plan goals to decrease vulnerabilities and minimize isolation. For example, the Sammamish River Trail can serve as secondary route to transport emergency supplies when traditional routes are impassable.

Along with an emergency conditions roadway management plan, design guidelines can help mitigate impacts to transportation networks. Guidelines could use incentives such as density and height bonuses, as well as departures from zoning requirements, to achieve hazard mitigating urban design. Examples of hazard sensitive urban design include designing plazas at key intersections to reduce the vulnerability to street blockage from fallen structures and trees. This would involve establishing a policy that considers building clearance in the redevelopment of streets within Downtown, Overlake and routes servicing the Fire Station 17.

	Action Items	Lead Agencies	Other Agencies/ Partners	Funding
4-1	Harden multi-modal connections between Downtown and Overlake to provide access to protected emergency centers.	Public Works	Planning Department, Metro	Parks District, Safe Routes to School
4-2	Develop bicycle and pedestrian network that can serve as secondary route to transport emergency supplies.	Public Works	Parks and Recreation	Parks District, Safe Routes to School
4-3	Develop an emergency conditions roadway management plan. The plan will address installing traffic signals not reliant on the power grid, preemptively applying de-icer to roads and sidewalks at the time of major storm warnings, prioritize street clearing by key access points and community vulnerability (not road hierarchy), and other relevant issues.	Public Works	Emergency Response	Safe Routes to School, Federal grants
4-4	Modify design guidelines to promote incorporation of hazard sensitive urban design.	Planning Department		Federal grants

Table 23: Action Items for Strategy 4

Strategy 5

To mitigate against the functional loss of business communities, Redmond will develop and deliver business outreach programs.

Hazards Addressed by this Strategy								
Severe Storms	Earthquakes	Floods	Wildfires	Landslides	Pandemics	Heat Waves	Drought	Hazardous Materials
x	x	x	x	x	x	x	x	x

Risks Addressed by Strategy 5

Redmond is home to several major corporations, including Microsoft, Nintendo and Genie Industries. These corporations have vendor relationships with many local small businesses. The systemic interdependencies among these business networks are as vulnerable to significant earthquakes and winter storms as is the physical built environment.

Small businesses are located throughout Redmond within existing commercial centers and from home-based operations located within residential neighborhoods.

	Action Items	Lead Agencies	Other Agencies/ Partners	Funding
5-1	Develop a specific outreach program promoting existing contingency planning tools available through the Washington EMD Business Portal	Emergency Management	Planning department, Faith-based organizations, Chamber of Commerce	City Operating Budget
5-2	Encourage businesses to partner, thereby sharing resources and risks (e.g. cold storage, alternative power).	Emergency Management	Planning department, Faith-based organizations, Chamber of Commerce	City Operating Budget

Table 24: Action Items for Strategy 5

Strategy 6

To mitigate impacts from expected increases in incidences of shallow flooding, Redmond will build a flood tolerant community able to accommodate increases in low impact flooding

Hazards Addressed by this Strategy								
Severe Storms	Earthquakes	Floods	Wildfires	Landslides	Pandemics	Heat Waves	Drought	Hazardous Materials
x		x	x	x	x	x	x	

Risks Addressed by Strategy 6

As stated in the City of Redmond of the 2009 Comprehensive Flood Hazard Management Plan:

“because of the flood modifications to the Sammamish River channel made by the U.S. Army Corps of Engineers (USACE), the current impacts of flooding within the City of Redmond (City) pose little risk to public safety and relatively low risk to existing public and private development...however Redmond, faces the potential for an increase in flood hazard risks as a result of the tremendous population and development growth within the watersheds and the expected loss of key floodplain functions.”

Generalized flooding is not a current problem; however, climate change was not addressed in the 2009 Final Draft Comprehensive Flood Hazard Management Plan and projected changes in rainfall frequency and intensity, along with increases in upstream development, create a more problematic flood scenario.

Climate models for the region forecast increases in winter rainfall intensity, duration and frequency resulting in increasing shallow valley floor flooding. Summers will be drier. Winter flooding will become more frequent as the watershed built environment becomes increasingly impermeable. The low gradient of valley rivers will not provide the energy to discharge surface water quickly and ponding will occur throughout the Downtown, Sammamish Valley, Bear Creek and SE Redmond neighborhoods. With the valley floor being extremely permeable, sub-surface interflow processes will have a greater effect in removing ponding water than will surface drainages.

A secondary risk resulting from surface flooding will be from pollutants stored in garages and stores contaminating shallow aquifers and contaminating wells.

This Hazards Mitigation Plan incorporates the goals, principles and recommendation of City of Redmond Final Draft Comprehensive Flood Hazard Management Plan and its emphasis on stormwater and habitat management specifically to:

1. Prevent the loss of life, creation of public health or safety problems, and damage to public and private property from floods.
2. Maintain the varied uses of existing drainage pathways and floodplains within the City.
3. Minimize pollution hazards to surface and groundwater during flood events.
4. Promote watershed-based flood management strategies that balance engineering, economic, environmental, and social factors.
5. Restore properly functioning conditions for degraded floodplains.
6. Coordinate flood hazard planning and management with interested and affected parties in both public and private sectors.
7. Increase the public understanding of flood hazard issues.
8. Promote a comprehensive understanding of Redmond's floodplains and flood hazards.
9. Promote a stable, adequate, and publicly acceptable long-term source of financing flood hazard management work.
10. Reduce the long-term costs of flood hazard management.
11. Maintain an updated and accurate plan over time.

The Hazards Mitigation Plan differs from the Flood Hazard Management Plan in that it focuses on less frequent events that have a higher probable impact. Increases in watershed impermeability and global warming will increase the likelihood, albeit infrequent, of extensive shallow valley floor flooding. The probable flooding will not have an adverse impact if developments are made to be safe to fail. If pollutants are kept from entering the groundwater and homes are built above the base flood elevation (factoring future development and climate conditions), flooding will have a minimal adverse impact while preserving the natural beneficial floodplain processes.

In adapting to climate change the City and its residents should expect that in rare, though increasingly probable, flood events, shallow water will cover the land and understand that this flooding is both appropriate and beneficial.

The following steps can be taken to minimize the adverse impacts of flooding:

1. Simultaneously protecting existing development from flood and protecting ground water from harmful chemicals through localized ring dikes and berms.
2. Accommodating flooding through structure elevation and wet floodproofing.
3. Retreating off the floodplain where alternative sites are practicable.

Each of these strategies is mentioned in the draft Flood Hazards Management Plan. Not mentioned in that plan, or action items that should receive greater emphasis, include:

	Action Items	Lead Agencies	Other Agencies/ Partners	Funding
6-1	Monitoring localized climate change impacts.	Public Works	Planning department	City Operating Budget
6-2	Performing hydrologic and hydraulic analyses that factor in climate change scenarios as well as future land use.	Public Works	Planning department	Stormwater Utility Fund
6-3	Add flood storage lands to floodplain delineations that accommodate climate change scenarios and identify impacts. This may result in amending the Flood Hazards Management Plan.	Public Works	Planning department	Stormwater Utility Fund
6-4	Promote a discussion of the beneficial impacts of flooding within valley communities	Public Works	Planning Department, Parks Department, Board of Education	Stormwater Utility Fund

Table 25: Action Items for Strategy 6

NFIP Continued Compliance

The City of Redmond is a member in good standing of the National Flood Insurance Program. Redmond entered the NFIP in March, 1974. The City's Flood Insurance Rate Maps became effective in April, 2005. The maps are in paper form only. There are no repetitive loss or severe loss properties or structures currently located in the 100 year floodplain. The City has a dedicated Floodplain Manager. This is an auxiliary duty for this position. There is currently no certified Floodplain Manager on the City staff.

Redmond participates regularly in Community Assistance Visits (CAV) or Community Assistance Contacts (CAC). The last visit was conducted by the Department of Ecology in 2003. The next scheduled CAV visit will be in December 2009. In 2004, code changes took effect in Redmond to bring the permitting procedures into compliance with NFIP regulations. Redmond employs a zero rise floodplain requirement for all building. This exceeds the current NFIP requirement. Redmond does not participate in the Community Rating System (CRS) at the time of this writing. King County is a participant in the CRS and the draft Comprehensive Flood Hazard Management Plan for the City recommends that Redmond pursue participating in the CRS in the future.

Federal Requirement for Monitoring, Evaluating, and Updating the Plan

This plan is an update of the 2004 City of Redmond Hazard Mitigation Plan (HMP). Although it is an update, this document has been redesigned so that it looks, feels, and reads differently than the original. This is due to several factors: new hazard information has become available that drives new definitions of risk, the City has matured and new capabilities are now available, and the new format will allow readers to more easily understand the content. In addition, the 2004 HMP included several action items that have been completed, creating an opportunity for developing new mitigation strategies. The Mitigation Implementation Committee (MIC) constituted at the writing of the 2004 HMP was tasked with monitoring the strategies described in the Plan. That committee did not effectively track the progress of the strategies. As a result, a consultant, Bob Freitag, was hired in 2006 to complete a mid-course review and update of the 2004 Plan. The strategies identified in the 2004 Plan were then updated in the 2006 revision and are included in this plan. This plan includes a much more thorough process for tracking the progress of the 2009 mitigation strategies. The MIC, under the direction of the Planning Director will meet at least annually to track the progress of the strategies and make any adjustments or recommendations as required. Another key aspect of the Plan monitoring system requires that the MIC review the Plan, especially the strategies and vulnerabilities, in the aftermath of a declared event. The Plan should be updated or modified pursuant to the results of that review.

Plan Maintenance Process FEMA Requirements

Requirement §201.6(b)(4)(i): A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.

Requirement §201.6(c)(4)(ii): A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.

Requirement §201.6(c)(4)(iii): Discussion on how the community will continue public participation in the plan maintenance process.

The plan maintenance section details the process that will ensure that the City of Redmond HMP remains a comprehensive and useful document throughout the five-year update cycle. The following plan maintenance process section outlines the procedure for monitoring and evaluating the plan and producing an updated plan every five years. This section also explains how the City intends to incorporate the mitigation strategies outlined in the HMP into existing plans and programs, such as the Comprehensive Plan, and the Municipal Code, among others. Furthermore, this chapter describes how the City will integrate public participation throughout the plan implementation process. Finally, there is a section on emerging trends in the field of hazards mitigation planning.

14.1 Monitoring, Evaluating, and Updating the HMP

In support of the Planning Department, the lead agency for the HMP, the Redmond Office of Emergency Management (OEM) will monitor the implementation of mitigation actions identified in the Plan. The OEM will maintain adequate mitigation planning staff to monitor and evaluate the Plan. As part of the monitoring and evaluation processes, the OEM will work at a minimum to:

- Provide a summary of any hazard events that occurred during the prior year and the impact on the community.
- Review successful mitigation strategies identified in the HMP.
- Explain why any strategies have not been implemented.
- Review the action items to determine if the project timelines need to be amended and if there are changes in funding or grant opportunities.
- Create recommendations for new mitigation projects.
- Provide a report on impacts of any other planning programs or initiatives within the City that involve hazards mitigation.
- Assess the current version of the Plan and determine the necessary improvements for the five-year HMP update.
- Conduct site visits to obtain reports of completed or initiated mitigation strategies to incorporate in the plan update as needed.
- Research and document new natural disaster information pertaining to Redmond during the five-year HMP update cycle.
- Organize annual meetings with the Mitigation Implementation Committee (MIC) to discuss relevant hazards mitigation issues, provide status updates, and discuss available grant opportunities.
- Convene a meeting of the MIC following a natural disaster or when funding is announced to prioritize and submit potential mitigation actions for funding.

Section 201.6.(d)(3) of Title 44 of the CFR requires that the HMP be reviewed, revised if appropriate, and resubmitted to FEMA for approval in order to remain eligible for funding given out by FEMA under the Disaster Mitigation Act (DMA).¹⁴² The HMP will be updated every five years to reflect the results of the annual reports and on-going plan monitoring and evaluation by the OEM and MIC. The OEM and MIC will assess and incorporate recommended comments expressed by FEMA in the initial review into the plan revision. At the end of the planning cycle, the OEM will submit the updated Plan to the Emergency Management Division of the State of Washington for review and preliminary approval. The State will then submit the Plan to FEMA for a final review. After the State and FEMA have approved Redmond's HMP, the City will formally adopt the Plan by a City Council vote.

As part of this process, some minimum requirements will need to be met, including:

- The hazards risk assessments will be reviewed and updated using best available information and technologies on an annual basis. This effort shall include new analysis of Redmond's Hazard Inventory Assessment using new data available to the city (e.g. recently completed LiDAR datasets available through King County). (See **Map 31, Differences Between Current County Data and KC LiDAR Data**)
- Critical structures will be evaluated and mapping will be updated.
- The action items will be reviewed and revised to account for any actions

¹⁴² Title 44 §201.6(c)(3), of the Code of Federal Regulations, Chapter 1 Federal Emergency Management Agency, Department of Homeland Security, Part 201 Mitigation Planning, <http://frwebgate.access.gpo.gov/cgi-bin/get-cfr.cgi>.

completed, dropped, or changed, and to account for changes in the risk assessment or new City policies identified under other planning mechanisms (such as the Comprehensive Plan), as appropriate.

- The draft HMP update will be sent to appropriate agencies for comment.
- The public will be given an opportunity to comment prior to adoption.
- The City Council will adopt the updated plan, as approved by FEMA.

14.2 Incorporation Into Existing Planning Mechanisms

The HMP is based on information available at the time the plan and its updates are written.¹⁴³ In addition to the HMP, the City of Redmond has a series of master plans, ordinances, and guidelines by which the City abides when considering planning and development.

Per Washington State's Growth Management Act (1990), Redmond first created and adopted a Comprehensive Plan in 1995 with an allowance for yearly amendments.¹⁴⁴ This plan has been updated, and the most current Comprehensive Plan was adopted in 2006. This plan is the primary guideline for the City's planning and development goals.¹⁴⁵ Additional documents include, but are not limited to:

- General Documents
 - o The Redmond Municipal Code
 - o City Ordinances
- Land Use Documents (additional to the Comprehensive Plan)
 - o Community Development Guide (includes Zoning Code)
- Public Works Documents
 - o Stormwater Management Program Plan
 - o Transportation Master Plan
 - o Water Quality (Including Wellhead Protection Ordinance)

Through adoption of this HMP, the City Council will coordinate the HMP recommendations with the recommendations of these additional documents, particularly as they pertain to achieving Comprehensive Plan goals and objectives. Although the City's Comprehensive Plan does not explicitly mention coordination with the HMP, many of the HMP strategies support the goals of the Comprehensive Plan. The following are examples of correlations between the HMP and the Comprehensive Plan's goals:

Land Use/Planning: Downtown and Overlake

The Comprehensive Plan goals are to enhance the vitality of the existing Downtown area through retail, business, protection of historic buildings, and creating pedestrian environments. While the Downtown area will act as the cultural and economic core

¹⁴³ City of Santa Cruz, "Local Hazard Mitigation Plan, 2007-2012," <http://www.ci.santa-cruz.ca.us/pl/LHMP/LHMP%20Final%20Sept%2011%202007.pdf>.

¹⁴⁴ City of Redmond, "Plan Updates," <http://www.redmond.gov/intheworks/Redmond2022/proposedupdates.asp>.

¹⁴⁵ City of Redmond, "Redmond Comprehensive Plan, 2006," <http://www.codepublishing.com/WA/Redmond/CompPlan/PDF/>.

of Redmond, the Comprehensive Plan also encourages the development of Overlake as an urban center focusing on high technology and employment.¹⁴⁶

The HMP strategies recommend that Redmond take advantage of decentralizing the core centers by providing redundancy of critical facilities in the Overlake and Education Hill neighborhoods. This redundancy provides a secondary area of refuge and support in the case of a hazard event that creates isolation between Downtown, Overlake and Education Hill. It also allows for Redmond to be prepared for the several types of earthquakes that would have varying impacts on the City.

Community Character and Historic Preservation

Redmond's historic character is a vital part of its identity. Comprehensive Plan goals of maintaining historic districts, buildings, and gathering spaces is enhanced by the integration of Redmond's identity as a technological center.¹⁴⁷ The HMP encourages this integration by recommending that historic buildings are seismically retrofitted to meet current building codes.

Human Services

The Comprehensive Plan calls for encouragement of accessibility for human service agencies serving Redmond as well as additional awareness of the need for human services within the City.¹⁴⁸ In the event of a hazard, the HMP supports this goal by proposing an educational tool, which will prepare community members to independently survive a hazard for more than three days. The HMP also proposes the strategy of providing food supply centers within neighborhood schools and similar facilities in the event that a hazard renders household kitchens unusable.

Transportation

Redmond's transportation goals are to encourage multi-modal transportation including vehicular, pedestrian, and bicycle access throughout the City.¹⁴⁹ The HMP encourages the development or reconfiguration of the City's transportation network such that supplies and people can be moved within, into, and out of Redmond in the event of a hazard. The HMP particularly addresses the development of the non-motorized trail system as a means of emergency transportation.

Utilities

The Comprehensive Plan goals are to provide utilities such as water, electricity, sewer and waste removal, gas supply, and other household utilities.¹⁵⁰ The HMP encourages the retrofitting of existing utility supply equipment with safe to fail mechanisms to supplement the Comprehensive Plan goal.

Plan Consistency

When updating the HMP or other planning documents, the City should coordinate

¹⁴⁶ Ibid.

¹⁴⁷ Ibid.

¹⁴⁸ City of Redmond, "Redmond Comprehensive Plan, 2006," <http://www.codepublishing.com/WA/Redmond/CompPlan/PDF/>.

¹⁴⁹ Ibid.

¹⁵⁰ Ibid.

with existing plans. This coordination will encourage common goals throughout the plans and facilitate the creation of policies for plan implementation. In addition to plan consistency, ongoing consideration of strategy and action item implementation should occur during capital improvement project (CIP) development.

14.3 Continued Public Involvement

Redmond is committed to continued public involvement in the hazards mitigation planning and review process. During all phases of plan maintenance, the public will have the opportunity to provide feedback. The 2009 Plan update will be maintained and available for review on the City of Redmond's website. Individuals will have an opportunity to submit comments for the Plan update at any time by e-mail. Upon initiation of the next HMP update process, a new public involvement strategy will be created. This strategy will be based on the needs and capabilities of the City at the time of the update. At a minimum, this strategy will include the use of local media outlets within the planning area and the City's website prior to the submission of the next Plan update. Redmond will post a notice on its website requesting feedback on an updated draft HMP. The Project Team will hold community involvement meetings with representatives from academic institutions, the private sector, community groups, and neighboring jurisdictions. This will provide the public an opportunity to express their concerns, opinions, or ideas about any updates or changes to the Plan that are proposed.

14.4 Emerging Trends

The world's urban population is growing, as is the importance of cities to the economic health of their respective countries. Unfortunately, many of the elements that define cities also contribute to their vulnerability. Population growth and further development in hazard-prone areas is increasing the vulnerability to natural hazards.

For example, many of the fastest-growing areas in the United States are in the wildland-urban interface, and development in these areas increases the threat of wildland fires. Experts estimate that between 1990 and 2000, 60% of all new housing units in the United States were built in the wildland-urban interface, and that by 2000 about 38% of housing units overall were located in these areas.

Further, key scientific assessments indicate that climate change is expected to alter the frequency and severity of severe weather and related natural hazards. Global temperatures have increased over the last 100 years, a trend expected to accelerate over the next century. Along with severe weather, increased temperatures will increase drought occurrences, which, in turn, increase the risk of wildland fires. The changing character and degrees of hazards risks require adaptation, including comprehensive efforts to reduce urban vulnerability and more proactive measures to mitigate hazards impacts.

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Item 1: Utility Mailer, Sent to Residents

Help Redmond Prepare for Natural Hazards	
<p>Help the City of Redmond prepare for future winter storms, earthquakes, and other hazards <i>AND</i> get the information you need to protect your home or business. Please take the following two easy steps to help update the Redmond Hazard Mitigation Plan.</p> <p>1) Take the short Hazard Preparedness Questionnaire by following the link found at:</p> <p style="text-align: center;">www.redmond.gov</p> <p>2) Share your thoughts and find out more at Redmond City Hall from 7:00 PM to 8:30 PM on May 14, 2009 in the Bytes Café.</p> <p style="text-align: center;">CITY OF REDMOND</p>	

Item 2: Sample Outreach Email

Dear Principal,

I'm writing on behalf of the University of Washington's Urban Planning Graduate Program. We're working with the City of Redmond to update the City's Hazard Mitigation Plan. An important part of the plan is to ensure that all vulnerable populations, such as Redmond's youth, are protected from the effects of natural hazards like the winter storms we experienced at the end of 2008. We'd like to ask for your help in gathering the information needed to prepare this plan.

In order to for us to develop relevant governmental strategies, we would like to find out what preparedness and mitigation actions families have already taken. To that end, we have created a questionnaire on the Redmond City website, at <http://www.redmond.gov/surveys>. The Hazard Questionnaire is designed to gauge whether families have prepared for the isolation and separation they may face in hazard situations, solicit feedback on potential strategies, and to provide families with useful planning information. Of course, the questionnaire is confidential. The survey will be open until 6/15/2009.

We'll also be holding an interactive public discussion at 7:00pm on May 14, 2009 in the Bytes Café in City Hall to get more information from residents and share our findings to date.

We'd like to ask for your help in letting parents know about the questionnaire and the public meeting. We've prepared a short message at the end of this note that could be included in any web calendars, email or newsletters you regularly send to parents. Or, if you have another preferred communication method, we would be happy to work with you.

If you have any questions about the questionnaire or hazard mitigation planning project, please feel free to call me at the number below.

Thanks,

John Vander Sluis
Masters in Urban Planning candidate, 2010
Masters in Public Administration candidate, 2010
jvander@u.washington.edu
802-310-1259

Attached Message:

Help the City of Redmond and your family prepare for winter storms, earthquakes, pandemics, and other hazards. The City of Redmond and UW need your input to update the City Hazard Mitigation Plan. Please take the following two steps to make sure the plan meets your family's needs:

- 1) Take the Hazard Mitigation Questionnaire at <http://www.redmond.gov/surveys> to let the City know what preparedness steps you've taken, what the greatest risks are to your family, and to find useful information to make sure you've taken every measure to protect your home and family.
- 2) Share your thoughts and get more information at the Hazard Mitigation Strategy public meeting from 7:00pm to 8:30 pm on May 14, 2009 at the City Hall Bytes Café.

Please contact jvander@u.washington.edu with any questions about the survey or the public meeting.

Item 3: Scenario Used in Public Meeting

Earthquake Scenario 1

- 6.7 on the Richter
- Leads to landslides
- Wednesday evening in spring
- Less than one minute of shaking, but more severe than the Nisqually quake
- Region-wide impacts

Physical structures	Natural environment	People	Economy, Communication, other systems
<ul style="list-style-type: none"> • Collapse of 520 and I-90 bridges → community isolation • Buildings throughout Redmond collapse • Buildings in the liquefaction zones (incl. downtown commercial) most likely to collapse. Wood frame buildings least likely to collapse • Buildings on and below steep slopes damaged by landslides • Olympic pipeline ruptures → water contamination, hazardous material leakage • Power lines fall → no electricity for days 	<ul style="list-style-type: none"> • Hazardous materials leak into the streams, wells, groundwater from storage areas in the NE and SE, Olympic pipeline, and broken sewage lines. 	<ul style="list-style-type: none"> • Injury from falling objects & buildings • Isolation in residential areas • Lack of access to food • Lack of access to clean water in the short term, long-term well water contamination • Risk of carbon monoxide poisoning from using charcoal indoors to heat/cook. 	<ul style="list-style-type: none"> • Employees unable to get to work • Vendors unable to deliver goods • Businesses unable to ship goods • Damaged business computers → Data loss • Perishable foods spoil in grocery stores • Police, fire, ambulance services unable to reach Redmond • Redmond emergency services unable to use streets • Damage to cell towers & lack of electricity for internet/TV → No communication for days • Landslides block roads for days, preventing transportation and restoration of electricity

Potential Earthquake 1 Mitigation Strategies

	Strategy	Cost	Benefit	
1	Encourage development of multiple mixed-use centers to minimize separation of residents and resources	Low	Moderate	
2	Review culvert and other critical utilities system age, quality, location	Low	Moderate	
3	Maintain emergency auxiliary power sources for critical sites	High	High	
4	Develop non-well water emergency water supply	High	Low	
5	Develop on-foot emergency response procedures to avoid overdependence on surface streets and mobile transportation	Low	Moderate	
6	Focus growth and redundant / complementary public services in both Overlake and Downtown centers	Moderate	High	
7	Reinforce transportation connections between and to Overlake and Downtown, including pedestrian and bicycle networks	Low-High	High	
8	Provide incentives for seismic retrofitting of historic buildings, including tax credits, low interest revolving loans, grants, and/or municipal bonds	High	Moderate	
9	Consider hazards resiliency when siting new public facilities, especially those essential for continuity of operations & emergency management	Moderate	Moderate	
10	Create incentives for developers to build plazas at intersections to reduce street blockage from damaged buildings	Low	High	
11	Limit pedestrian overpasses to places where they are essential for pedestrian mobility	Low	Moderate	
12	Identify & create parks and open spaces for meeting places following events	Low	Low	
13	Identify, retrofit bike paths & secondary roads that can transport emergency supplies post-quake	Moderate	Moderate	
14	Inform citizens of the risks and response methods in a hazardous materials leak	Low	Low	
15	Strengthen building, structure, and storage codes for hazardous materials facilities	Low	Low	
16	Develop a backup switchboard for 911 calls to ensure redundancy of emergency service networks	Low	Low	

Item 4: Public Meeting “Passport”

<p>Welcome to the Redmond Hazards Mitigation Plan Update public meeting!</p> <p>Please take some time to familiarize yourself with the hazards Redmond may face in the future. The boards around the room feature information on the likely and unlikely hazards that could affect our region. Visit all of the boards - any order will work - and check the boxes as you go. Our team is on hand to answer your questions.</p>	
<p>Earthquakes - Earthquakes like the Nisqually quake can affect Redmond and its connections to the rest of the region. Put a pushpin in the map at Station #1 to mark your home or office. Looking at the liquefaction area on the map think of the other buildings you use that might be made unsafe or inaccessible during a quake.</p>	<input type="checkbox"/>
<p>Floods - The Sammamish River floodplain is broad enough that floodwaters would rarely exceed a foot in depth. Nonetheless, lasting damage can occur. What kinds of damage can this level of flooding cause? What about floods that occur in winter? Write your ideas on the map with the post-it notes provided.</p>	<input type="checkbox"/>
<p>Wildfires - Why talk about fires in a place as wet and green as Redmond? Many scientists predict longer and drier summers in our future. Does it make sense to safeguard these areas now? If so, how? What parts of Redmond would you protect to preserve the city's natural character?</p>	<input type="checkbox"/>
<p>Landslides - Landslides may be triggered by severe rains or winter storms, or from earthquakes. What streets might be closed due to landslides? Who uses those streets? Are there alternative routes available?</p>	<input type="checkbox"/>
<p>Hazardous Materials - Industries rely on chemicals that could present risks to people who are exposed to them. The Olympic pipeline running through the western part of Redmond is protected by a buffer that restricts any new development. Nonetheless, a spill could contaminate wells and groundwater. How else can we minimize our risk of exposure to these chemicals?</p>	<input type="checkbox"/>
<p>Heatwaves and Droughts - These hazards are highly unlikely to affect Redmond in the near future, although climate change could increase the odds. What preventative measures do other regions take that might make sense in Redmond?</p>	<input type="checkbox"/>
<p>Winter Storms - Last winter took many of us by surprise. Just like you, Redmond will be thinking of new ways to prepare for the risks of snow and ice. Using a post-it write your thoughts on how the city can best use its resources during snowstorms.</p>	<input type="checkbox"/>
<p>Pandemics - We've all heard about the recent swine flu epidemic. Was Redmond at risk, or was it all just overreaction? What additional measures could we have in place to make people feel secure even when the level of risk is unknown?</p>	<input type="checkbox"/>
<p>Thank you! Your participation and thoughts are very important. Please join us for a short exercise at Table ____.</p>	

Item 5: Public Meeting Agenda

Agenda

- 7:00 Welcome and Sign-In
Informational Hazard Station Visits
- 7:25 Student Introduction/Hazards Presentation
- 7:35 Scenario and Strategies Workshops
- 8:00 Large Student/Public Regroup
Discuss workshops results and identify themes
- 8:10 Wrap Up and Conclusion
Answer any remaining questions/comments from the public

What is Hazards Mitigation Planning?

The Hazards Mitigation Plan identifies the hazards Redmond faces (like severe storms, earthquakes, or pandemics) and outlines a set of strategies that can be implemented to lessen the impacts of those events. As part of this process we are working in conjunction with the Mitigation Implementation Committee or MIC, made up of Redmond City staff in Hazards Mitigation related fields such as the Emergency Management, Parks and Recreation, and Public Works. Mitigation can be defined as actions taken to prevent or remove the need to prepare, respond to, and recover from a hazard. Mitigation actions are strategies that can be done prior to a hazard, and are long term in scope. An example of a mitigation strategy would be securing alternative emergency water supplies for the City. This would remove the need to prepare stockpiled water, respond with deliveries of water to those who have lost supply, and recover by treating people who have not had access to water.

Please remember to take the short Hazard Mitigation Questionnaire at: **www.redmond.gov/surveys**
Feel free to contact us with any comments or questions you may have at: **studio67@u.washington.edu**

Thanks for coming out and participating tonight!

The University of Washington
College of Built Environments
Department of Urban Design and Planning

Item 6a: MIC Meeting #1 Agenda

March 12, 2009

City of Redmond
Hazard Mitigation Planning Meeting
Kick off meeting with Mitigation Implementation Committee (MIC)

Agenda – Introduction and scoping meeting

1. Statement of purpose – Tom Osborn, Bob Freitag
2. Introductions – MIC and Project Team
3. Presentation of Scope – Tom Osborn, Bob Freitag
4. Discussion of status of Action items – Bob Freitag
5. Determination of priority hazards – Bob Freitag
6. Issue of Concern (As determined in 2006 and as perceived by Student Project Teams – Amanda Engstfeld
7. Clarification of public planning process – Tom Osborn, Brandon Born
 - a. Interactions with City
 - b. Data sources
 - c. Interaction with neighborhoods
 - d. Survey
8. Strengths, Weaknesses Opportunities and Threats (SWOT) – Bob Freitag
9. Next MIC meeting – Tom Osborn

Item 6b: MIC Meeting #1 Notes

Memo

To: Redmond Project Team
From: Bob Freitag
Subject: Notes on MIC meeting
Date: March 13, 2009

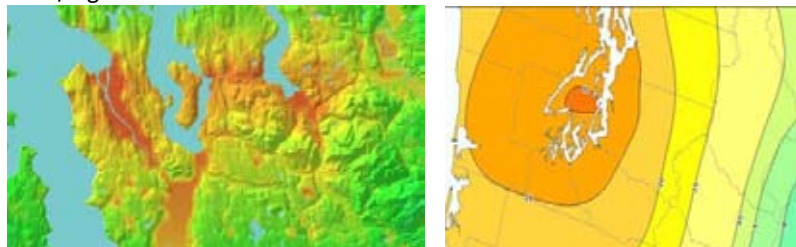
Issues of concern: (in no particular order)

1. Isolation:

- a. Concern about Redmond being isolated from surrounding communities
 - i. Business with Just-in-time issues
 - ii. 202 and 520 damage isolating City
 - iii. Many workers live outside city – business and city employees.
- b. Neighborhoods being isolated from commercial areas and other neighborhoods
 - i. Little walkability
 - ii. Neighborhoods lack services that can be reached on foot
 - iii. Ed...? Hill Neighborhood was isolated during 2008/2009 winter storm
 - iv. Commercial areas being isolated from other commercial areas as a result of earthquake and to limited degree – severe winter storm.
 - v. GIS task – look at street slopes and where streets cross vulnerabilities (street, small culvert at foot of slide area. Scenario could be that slide debris blocks culvert, dams water then when pressure exceeds strength of roadway the road washed out and the debris flows down hill causing more damage.

2. Frequency:

- a. Mitigation Plan should concentrate on higher frequency issues
 - i. When discussing earthquake solution may be to use higher frequency/lower impact probabilistic intensities to guide mitigation strategies but build in a fail safe for earthquakes such as the Seattle Fault. PGAs for Probabilistic intensities range from 20 – 30% PGA range. A Seattle Fault scenario cause PGA above 50 – 1.00%. Solution -- Build in preparedness and response measures to address a Seattle Fault, and mitigate to probabilistic intensities.
 1. Seattle Fault M6.7, epicenter Seward Park
 2. PGA with soil amplification
 3. Red: 1 g or greater
 4. Yellow: ~ 2/3 g
 5. Green: 1/3 g or less



3. Economy

- a. How will effect vulnerabilities

4. Power Outages are frequent

5. Debris Management

- i. Earthquakes generate lots of debris – look at King County, City debris management Plan.

Item 7: MIC Meeting #2 Agenda

MIC2 Agenda (90 minute meeting)

April 16, 2009

DRAFT

University of Washington Representatives: Chilan Ta, Ching Chan, Daniel Kastoryano , Doug McIntyre, Emily Slotnick and Michael Xenakis

I. Introduction and Context

II. Risk Assessment presentation and Q&A

- a. Earthquakes
- b. Landslides
- c. Winter Storms
- d. Floods
- e. Heat and Drought
- f. Fires
- g. Pandemics
- h. Hazardous Materials

III. Strategies Dot Exercise

Participants are handed 3 dots and asked to place them on the board according to which 3 strategies they see they could contribute to the most/can see they play a significant/relevant role, e.g. "As a representative of your department, thinking about what services you provides for Redmond area, under which hazard-risk category do you see yourself making the most contribution?"

Savings Bank for Ideas and Comments:

Record your ideas, comments, or suggestions in the space below, continued onto the back of the sheet. Alternatively, email any other ideas, comments, or suggestions to us at studio67@u.washington.edu

Item 8: MIC Meeting #3 Agenda

MIC3 Agenda (2 hour meeting)

May 19, 2009

DRAFT

I. Introduction

Discuss the public meeting, where the class is in the Plan process, the meeting agenda

II. Poster Board Sessions

6 groups will be made to view each hazard map and hazard specific strategies.

III. Group Discussions

Each group will be assigned one hazard to briefly summarize (aloud to everyone) the strategies and their opinions.

IV. Dot Exercise

Each hazard will have its own strategy dot board for meeting participants to place dots on their "favorite" strategies.

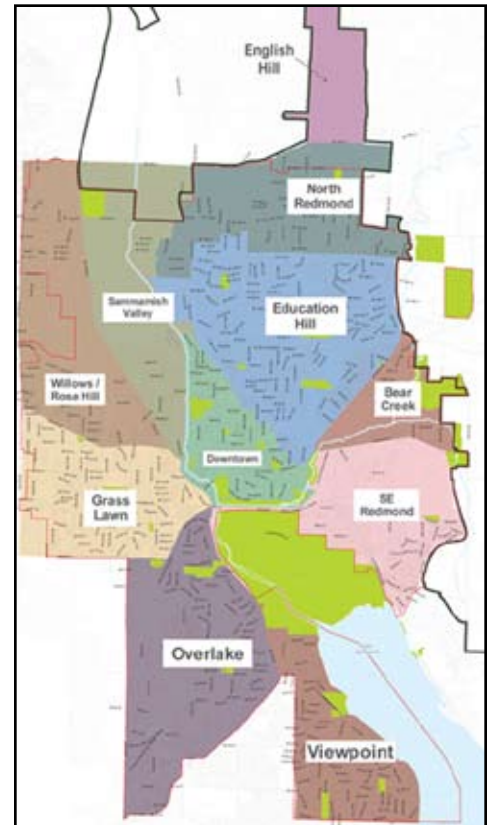
V. Q/A and Comment Session

Item 9: Public Questionnaire Results

Why is Redmond important to you?	
I live in Redmond	45
I work in Redmond	9
I live and work in Redmond	31
Total	85

Choose the neighborhood in Redmond where you...				
	...live	%	...work	%
English Hill	1	1.3%	0	0.0%
N. Redmond	11	14.5%	2	5.0%
Sammamish Valley	0	0.0%	2	5.0%
Willows/Rose Hill	2	2.6%	1	2.5%
Education Hill	34	44.7%	3	7.5%
Bear Creek	2	2.6%	0	0.0%
Downtown	4	5.3%	8	20.0%
Grass Lawn	2	2.6%	0	0.0%
SE Redmond	0	0.0%	2	5.0%
Overlake/Microsoft	9	11.8%	22	55.0%
Viewpoint	4	5.3%	0	0.0%
Redmond Ridge	7	9.2%	0	0.0%

What types of hazards have you experienced in the past? Select all that apply.		
Earthquake	68	80.0%
Landslide	5	5.9%
Winter storm	82	96.5%
Flood	25	29.4%
Heatwave	38	44.7%
Drought	34	40.0%
Wildfire	11	12.9%
Disease pandemic	2	2.4%
Hazardous material	10	11.8%
None	1	1.2%
Other*	10	11.8%
Others: volcano eruption (3), traffic (2), hurricane, tornado, power outage, no snow removal.		



Item 9: Public Questionnaire Results

From the choices below, please rank the hazards that concern you the most in terms of how they may affect Redmond.						
	1st Choice	2nd Choice	3rd Choice	4th Choice	5th Choice	Weighted Score
Earthquakes	49	25	5	2	1	365
Landslide	0	1	3	7	0	27
Winter Storm	28	34	5	5	1	302
Flood	1	7	12	5	4	83
Heatwave	0	0	0	2	6	10
Drought	0	1	4	6	4	32
Wildfire	0	0	11	6	2	47
Pandemic	2	5	11	7	9	86
HazMat	1	2	7	9	8	60
Terrorism	1	5	9	5	7	69
Other*	3	2	1	0	0	26
"Other" included: no snow removal, helicopter crashes, wind storms, traffic						
"Weighted Score" = (5*1st + 4*2nd + 3*3rd + 2*4th + 1*5th)						

Top 5 Hazards (as ranked)	
1st	Earthquakes
2nd	Winter storm
3rd	Pandemic
4th	Flood
5th	Terrorism

What steps have you taken to prepare your home for hazards or emergencies?		
Smoke detectors	73	96.1%
Flashlights	73	96.1%
Battery-powered radio	62	81.6%
Fire extinguisher	65	85.5%
Spare batteries	63	82.9%
Secured water heater	56	73.7%
Stored extra food	57	75.0%
Stored extra water	54	71.1%
Located util shut-offs	51	67.1%
Medical supplies/prescriptions	38	50.0%
Fastened home to foundation	32	42.1%
First Aid/CPR cert	30	39.5%
Supply kit	31	40.8%
Fire escape plan	21	27.6%
Family communication plan	24	31.6%
Secured tall furniture	21	27.6%
Moved heavy objects	15	19.7%
Other*	5	6.6%
None	0	0.0%
* Other Includes: purchased electric generator, removed hazard trees, emerg. supplies in cars, taking CERT cleasses		

Item 9: Public Questionnaire Results

In general, how prepared do you feel you are (as a resident) for disasters in Redmond?		
Highly prepared	12	14.1%
Somewhat prepared	52	61.2%
Somewhat unprepared	17	20.0%
Highly unprepared	4	4.7%
Not sure	0	0.0%

What sources of information about disasters have you . . .				
ever used?			found most valuable?	
Federal govt	18	23.7%	3	3.9%
State govt	16	21.1%	5	6.6%
Local govt	27	35.5%	11	14.5%
Military	2	2.6%	1	1.3%
Red Cross	22	28.9%	8	10.5%
Newspaper	23	30.3%	9	11.8%
TV/Radio	24	31.6%	9	11.8%
Coursework	7	9.2%	2	2.6%
Place of work	15	19.7%	4	5.3%
Public meetings	6	7.9%	0	0.0%
Church	3	3.9%	3	3.9%
Other*	19	25.0%	21	27.6%

*Other Includes: internet resources (5), magazine, personal experience

To the best of your knowledge, do you . . .		
live in floodplain?	Yes	4
	No	69
	Don't Know	3
have floodpain insurance?	Yes	3
	No	10
	Don't Know	63
live in liquefaction zone?	Yes	4
	No	21
	Don't Know	51
have earthquake insurance?	Yes	26
	No	14
	Don't Know	36

Item 9: Public Questionnaire Results

What steps has your employer taken to prepare your business for a disaster?		
Trained employees in preparedness and response	21	52.5%
Conducted emergency drills	20	50.0%
Created evacuation plans	20	50.0%
Identified vital records and protect computer data and equipment	15	37.5%
Established communication plans to communicate with employees, vendors, customers, and the media.	15	37.5%
Offsite/out of area back up of computer files and physical papers	12	30.0%
Prepared sources of emergency power to support critical operations and secure records	12	30.0%
Provided employees with information to prepare for disasters at their homes to enable them to return to work sooner.	11	27.5%
Conducted hazard vulnerability analyses of all buildings	10	25.0%
Encouraged and track annual influenza vaccination for employees	10	25.0%
Made sure insurance covers business equipment and supplies	8	20.0%
Created an emergency supply kit with food, first aid, and other supplies.	5	12.5%
Set up an emergency cash reserve	5	12.5%
Other (includes: inviting emergency services speakers, don't know (3)	6	15.0%
Purchased business interruption insurance	4	10.0%
Developed and planned for scenarios likely to result in an increase or decrease in demand for your products and/or services during a pandemic (e.g. effect of restriction on mass gatherings, need for hygiene supplies)	5	12.5%
Shared best practices with other businesses in your communities, chambers of commerce, and associations to improve community response efforts	4	10.0%
Stored enough drinking water for employees and customers in case an event strands them at work – at least one gallon per person per day - for a minimum of three days	3	7.5%
Anchored office equipment, production equipment, and warehousing facilities	3	7.5%
Determined potential impact of a pandemic on company business financials using multiple possible scenarios that affect different product lines and/or production sites	4	10.0%
Practiced table-top exercises	2	5.0%
Replaced windows with shatterproof glass	2	5.0%
Trained and prepared ancillary workforce (e.g. contractors, employees in other job titles/descriptions, retirees)	1	2.5%
None	3	7.5%

Item 9: Public Questionnaire Results

In general, do you feel your workplace is prepared for disasters that could occur in Redmond?		
Yes	21	52.5%
No	7	17.5%
Not sure	12	30.0%

Do you have people with any of the following characteristics living in your home?		
Children (under 18)	37	48.7%
Senior citizens	11	14.5%
People with physical disabilities	2	2.6%
ESL	6	7.9%

What resources do you think could better prepare your workplace for a disaster or emergency?		
Business-oriented disaster planning	17	42.5%
None	12	30.0%
Mitigation incentives	9	22.5%
Tax breaks	9	22.5%
Recovery grants	6	15.0%
Flood risk info	8	20.0%
Recovery loans	3	7.5%
Business helpline	3	7.5%
Flood repair info	5	12.5%
Financial literacy	2	5.0%
Other	3	7.5%
Help with temp workers	0	0.0%

Do you have people with any of the following characteristics at your work?		
Senior citizens	18	45.0%
People with physical disabilities	26	65.0%
ESL	26	65.0%

Please select the age group that contains your age	
under 18	0
18 to 29	3
30 to 39	27
40 to 49	21
50 to 59	22
60 or older	9
refused	3

Where did you learn about the questionnaire?		
Utility flyer	44	51.8%
Redmond homepage	15	17.6%
Word of mouth	3	3.5%
UW student	8	9.4%
Other	15	17.6%
"Other" Includes:		
community email		
Redmond Elementary / School Email (2)		
Neighborhood newsletter		
Announcement from homeowners association (4)		
Greater Redmond Chamber of Commerce		
News		
email request		
Handed a flyer at Redmond Town Center		
Redmond Blog (3)		
City of Redmond announcement		

Please select the income group that contains your income	
<\$30,000	3
\$30,000 - 60,000	5
\$60,000 - 90,000	12
\$90,000 - 120,000	18
\$120,000 +	27
refused	11

Item 9: Public Questionnaire Results

What strategies should the city take to mitigate the effects of hazards?					
	Very worthwhile	Somewhat worthwhile	Not worthwhile	A waste of time and resources	Relative Rank
Mitigating future development	69.8%	20.9%	3.5%	4.7%	156
Mitigating existing development	36.0%	46.5%	8.1%	8.1%	110
Natural resources	60.5%	26.7%	8.1%	3.5%	144
Structural projects	39.5%	51.2%	5.8%	2.3%	128
Emergency services	87.2%	10.5%	1.2%	0.0%	185
Public awareness and education	54.7%	40.7%	1.2%	2.3%	148
"Relative Rank" = (2*very worthwhile + 1*somewhat worthwhile - 1*waste of time)					
Other Responses Include					
I think it's up to people to prepare themselves or take responsibility for where they live. Being able to offer information to people would be the best thing the city could do for its current residents. Going forward, keeping people from doing things like building in poor locations is a minimal impact way to mitigate potential problems (such as through planning and zoning, building codes, open space preservation, and floodplain regulations).					
Alternative communication planning, awareness to public of disaster response/coordination center, report to community of supply stockpiles and planned distribution points in emergencies.					
In regards to emergency services, it would be great if the city utilized its website more for the community to gain information about exact road conditions, especially during winter storms (similar to Bellevue's website). Thank you.					
Regulatory incentives that encourage people to either build out of hazard areas or mitigate against them. Make individual property owners liable for mitigation strategies.					
The best approach is zoning and construction codes which prevent improper use of land subject to issues like floods and landslides. Construction codes should be rigid enough to ensure new buildings are earthquake resistant, fire resistant and contain mitigation features like sprinklers, fire extinguishers and solid construction practices. Don't develop flood plains for uses that are not compatible with lots of water!					
I am amazed at the level of un-education in the public, or at least at the level that communications are aimed at.					
Direct mailings to residences/business with reference to websites for more information. Incentive for business to have a disaster preparedness plan.					
Make sure info is in Redmond Focus magazine					
When there is a storm and the power might go out, the message from the city is to prepare for multiple days without heat. That is not good advice for apartment dwellers. Many of us have fireplaces - many of us don't know how to use them - please open community sites for heat and safety. When there is a storm, all the city facilities close - no senior center, city hall, etc. == those sites should stay open as safety sites for all major storms. By the way, no power = no web					
Community Action and Organizing to prepare for or after a natural disaster or hazard so that we can be better connected and help each other during rough times.					
Teach people that emergency packs should have plain water and real food (canned meat, fish, fruit etc.) and not merely junk like Cheetos and candy. Remind people to keep extra pet food and pet meds in their emergency packs along with a bottle of hydroge					

APPENDIX B: MITIGATION STRATEGY

Item 1: Benefit Cost Analysis of Action Items (1/3)

Strategy - Action Item	Description of Action Item	Project Benefit*	Project Cost**	Benefit / Cost***	Associated Hazards								
					Severe Storms	Earthquakes	Flooding	Wildland Fire	Landslides	Pandemics	Heat Waves	Drought	Hazardous Materials
One - 1	Develop an enhanced neighborhood based outreach program to better prepare visitors, residents and business owners to be isolated from expected services for extended periods (over 3 days). Program will be built on three successful programs. (1) Map Your Neighborhood (2) Block Watch (3) CERT	high	low	high	x	x	x	x	x	x	x	x	x
One - 2	Initiate a discussion of amending Comprehensive Plan to allow mixed uses within communities that may be isolated	high	low	high	x	x	x						
One - 3	Identify communities that would be isolated during a probable event, available private and public services and existing mutual aid systems.	high	low	high	x	x	x						
One - 4	Work with community to identify, implement and promote safe locations that will stock basic human needs.	high	low	high	x	x	x	x					
One - 5	Identify and create parks trail and open spaces for meeting places following hazards events.	high	low	high	x	x	x	x	x				x
Two - 1	Develop new City command center(s)/EOC away from downtown liquefaction and flood zones.	high	medium	medium	x	x	x						
	Until alternative sites can be developed, continue partnership with Microsoft.												

Benefit / Cost***
Low = B/C < 1
Med = B/C 1 - 2
High = B/C > 2

Project Cost**
Low = Existing budget
Med < \$1M in additional funds
High > \$1M in additional funds

Project Benefit*
Low = May save lives, or property and environment worth less than \$1 Million
Med = May save lives, property and environment worth < \$10 M but > \$1 M
High = Saves lives and/or > \$10 M in property or environment

APPENDIX B: MITIGATION STRATEGY

Item 1: Benefit Cost Analysis of Action Items (2/3)

Strategy - Action Item	Description of Action Item	Project Benefit*	Project Cost**	Benefit / Cost***	Associated Hazards								
					Severe Storms	Earthquakes	Flooding	Wildland Fire	Landslides	Pandemics	Heat Waves	Drought	Hazardous Materials
Two - 2	Develop alternative redundant services off floodprone, liquefiable lands.	high	medium	high	x	x	x						
Two - 3	Integrate the HMP goal of creating decentralized centers into the comprehensive plan to provide further support for existing policies supporting multiple centers. Consider hazards in general planning decisions	high	low	high	x	x	x	x	x	x	x	x	x
Three - 1	Provide incentives for seismic retrofitting of historic buildings, including tax credits, low interest revolving loans, code compliance, grants, and/or municipal bonds.	low	medium	low		x							
Three - 2	Create an inventory of susceptible buildings, culverts, roads and other critical utilities. Use inventory to prioritize retrofits of City assets.	low	medium	low	x	x	x		x				
Three - 3	Retrofit emergency response and operation centers, if necessary to withstand severe ground shaking	medium	medium	medium		x							
Four - 1	Harden multi-modal connections between Downtown, Overlake to provide access to protected emergency centers.	medium	high	low		x							
Four - 2	Develop bicycle and pedestrian network that can serve as secondary route to transport emergency supplies.	medium	low	medium	x	x	x						

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High = Saves lives and/or > \$10 M in property or environment

Project Cost**
Low = Existing budget
Med < \$1M in additional funds
High > \$1M in additional funds

Benefit / Cost***
Low = B/C < 1
Med = B/C 1 - 2
High = B/C > 2

APPENDIX B: MITIGATION STRATEGY

Item 1: Benefit Cost Analysis of Action Items (3/3)

Strategy - Action Item	Description of Action Item	Project Benefit*	Project Cost**	Benefit / Cost***	Associated Hazards								
					Severe Storms	Earthquakes	Flooding	Wildland Fire	Landslides	Pandemics	Heat Waves	Drought	Hazardous Materials
Four - 3	Develop an emergency conditions roadway management plan. The plan will address installing traffic signals not reliant on the power grid, preemptively applying de-icer to roads and sidewalks at the time of major storm warnings, prioritize street clearing by key access points and community vulnerability (not road hierarchy), and other relevant issues.	high	low	high	x	x	x	x	x				
Four - 4	Modify design guidelines to promote incorporation of hazard sensitive urban design.	medium	low	medium	x	x	x	x	x				x
Five - 1	Develop a specific outreach program promoting existing contingency planning tools available through the Washington EMD Business Portal	low	low	low	x	x	x	x	x	x		x	
Five - 2	Encourage businesses to partner, thereby sharing resources and risks (e.g. cold storage, alternative power).	medium	low	medium	x	x	x	x	x	x	x	x	x
Six - 1	Monitoring localized climate change impacts.	medium	low	medium	x		x	x	x	x	x		
Six - 2	Performing hydrologic and hydraulic analyses that factor in climate change scenarios as well as future land use.	medium	low	medium	x		x	x	x		x	x	
Six - 3	Add flood storage lands to floodplain delineations that accommodate climate change scenarios and identify impacts. This may result in amending the Flood Hazards Management Plan.	low	low	low			x					x	
Six - 4	Promote a discussion of the beneficial impacts of flooding within valley communities	low	low	low			x		x			x	

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Med = May save lives, property and environment worth < \$10 M but > \$1 M
High = Saves lives and/or > \$10 M in property or environment

Project Cost**
Low = Existing budget
Med < \$1M in additional funds
High > \$1M in additional funds

Benefit / Cost***
Low = B/C < 1
Med = B/C 1 - 2
High = B/C > 2

APPENDIX B: MITIGATION STRATEGY

Item 2: Benefit Cost Analysis of Action Items for Emerging Hazards

Action Items that Address Emerging Hazards				Associated Hazards								
Description of Action Item	Project Benefit*	Project Cost**	Benefit / Cost ***	Severe Storms	Earthquakes	Flooding	Wildland Fire	Landslides	Pandemics	Heat Waves	Drought	Hazardous Materials
	Identify what areas are most vulnerable to increased fire hazard caused by dry vegetation in case of a drought. Especially around vulnerable areas such as the pipeline.	low	medium	low			x				x	
	Use Class A roofing materials on city buildings that are tested ASTM E108 or UL 790.	low	high	low			x					
	Choose wall materials for city buildings that resist heat and flames, such as cement, plaster, stucco and concrete masonry.	low	high	low			x					
Project Benefit* Low = May save lives, or property and environment worth less than \$1 Million Med = May save lives, property and environment worth < \$10 M but > \$1 M High = Saves lives and/or > \$10 M in property or environment				Project Cost** Low = Existing budget Med < \$1M in additional funds High > \$1M in additional funds				Benefit / Cost*** Low = B/C <1 Med = B/C 1 - 2 High = B/C >2				

Project Benefit*

Low = May save lives, or property and environment worth less than \$1 Million
 Med = May save lives, property and environment worth < \$10 M but > \$1 M
 High = Saves lives and/or > \$10 M in property or environment

Project Cost**

Low = Existing budget
 Med < \$1M in additional funds
 High > \$1M in additional funds

Benefit / Cost***

Low = B/C < 1
 Med = B/C 1 - 2
 High = B/C > 2

Item 3: Benefit Cost Analysis of Items for Hazards Managed by Outside Agencies

Action Items for Hazards Managed by Outside Agencies					Associated Hazards								
Outside Agency	Description of Action Item	Project Benefit*	Project Cost**	Benefit / Cost ***	Severe Storms	Earthquakes	Flooding	Wildland Fire	Landslides	Pandemics	Heat Waves	Drought	Hazardous Materials
CAO	Restrict all building near or on steep slopes, near drainage ways or natural erosion valleys.	medium	low	medium		x			x				
EPA	Consider amendment of codes within Redmond if more stringent regulations are required for storage of hazardous materials and construction of their facilities	medium	low	medium									x
EPA	Consult building and fire codes for appropriate construction of facilities housing hazardous materials.	medium	low	medium				x					x
EPA	Isolate and/or buffer Tier II facility locations from residential/ commercial areas where appropriate in the future to minimize exposure risks.	medium	low	medium									x
Regional	Organize frequent review of the scientific research on the geology and meteorology of the Redmond area.	low	medium	low	x	x	x	x	x		x	x	
Project Benefit*		Project Cost***			Benefit / Cost***								
Low = May save lives, or property and environment worth less than \$1 Million		Low = Existing budget			Low = B/C <1								
Med = May save lives, property and environment worth < \$10 M but > \$1 M		Med < \$1M in additional funds			Med = B/C 1 - 2								
High = Saves lives and/or > \$10 M in property or environment		High > \$1M in additional funds			High = B/C >2								

Benefit / Cost***
 Low = B/C < 1
 Med = B/C 1 - 2
 High = B/C > 2

Project Cost**
 Low = Existing budget
 Med < \$1M in additional funds
 High > \$1M in additional funds

Project Benefit*
 Low = May save lives, or property and environment worth less than \$1 Million
 Med = May save lives, property and environment worth < \$10 M but > \$1 M
 High = Saves lives and/or > \$10 M in property or environment

Item 4: Benefit Cost Analysis of Rejected Action Items (1/2)

Rejected Action Items				Associated Hazards								
Description of Action Item	Project Benefit*	Project Cost**	Benefit / Cost ***	Severe Weather	Earthquakes	Flooding	Wildland Fire	Landslides	Pandemic	Heat Wave	Drought	Hazardous Materials
Develop an emergency conditions roadway management plan: lead education program for winter storm driving	medium	medium	medium				x	x				
Incentivize emergency radio use; provide emergency radio infrastructure and work with local broadcast stations to ensure real-time weather updates during heavy storm events.	medium	medium	medium	x				x				x
Design and implement permeable pavements to allow contamination-free seepage and incorporate groundwater management into future planning.	medium	high	low			x		x				x
Remove vegetation near vulnerable fire hazard areas	medium	medium	medium									
Encourage the purchasing of flood insurance	low	low	medium					x				x
Educate the public on personal flood mitigation strategies (e.g. sump pumps)	low	low	medium									x
Consider underground power routing in areas of high tree coverage for future development and design.	high	high	medium				x	x				
Develop an emergency conditions roadway management plan: install traffic signals not reliant on the power grid	high	high	medium				x	x				
Identify emergency management grants available for funding utility retrofits.	high	low	high	x		x						
Encourage multiple mixed-use development centers to minimize residential separation from resources.	high	low	high	x								

Benefit / Cost***
 Low = B/C < 1
 Med = B/C 1 - 2
 High = B/C > 2

Project Cost**
 Low = Existing budget
 Med < \$1M in additional funds
 High > \$1M in additional funds

Project Benefit*
 Low = May save lives, or property and environment worth less than \$1 Million
 Med = May save lives, property and environment worth < \$10 M but > \$1 M
 High = Saves lives and/or > \$10 M in property or environment

Rejected for one of the following reasons:
 (1) Not financially viable (2) City is already addressing the action item
 (3) Overlaps with another action item (4) Not feasible

Item 4: Benefit Cost Analysis of Rejected Action Items (2/2)

Rejected Action Items				Associated Hazards								
Description of Action Item	Project Benefit*	Project Cost**	Benefit / Cost ***	Severe Weather	Earthquakes	Flooding	Wildland Fire	Landslides	Pandemic	Heat Wave	Drought	Hazardous Materials
Develop a communication plan between the City and the public to identify emergency shelters	medium	low	medium	x			x	x		x		x
Provide incentives for residents in the slide hazard zone to update their buildings – increasing groundcover and installing flexible pipe fittings to avoid gas or water leaks	medium	high	low	x		x						
Maintain emergency auxiliary power sources for critical sites	low	medium	low	x				x				
Identify churches, schools and other areas that have air conditioning and could be opened to residents in the event of a heat wave.	low	medium	low						x			
Provide incentives for raising homes out of the floodplain	low	high	low					x				x
Design LID permeable pavements that incorporate filtration systems for runoff: this will enable water to slowly move down hillsides and minimize oversaturation.	medium	high	low	x				x				x
Restore natural meanders in river	medium	high	low									x
Provide incentives for residential home insulation upgrades, including energy efficient doors and windows.	low	high	low	x				x			x	

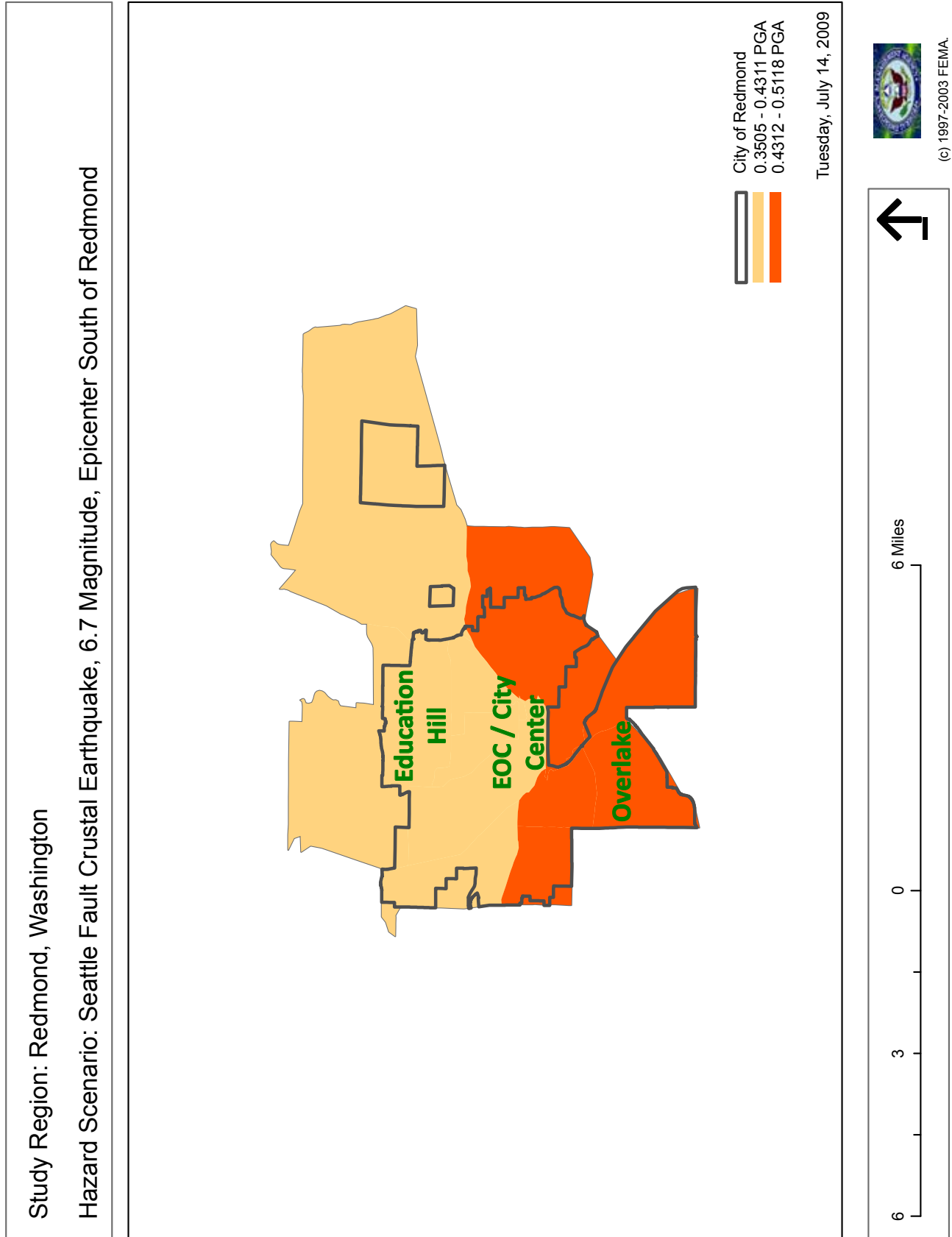
Project Benefit*
 Low = May save lives, or property and environment worth less than \$1 Million
 Med = May save lives, property and environment worth < \$10 M but > \$1 M
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Project Cost**
 Low = Existing budget
 Med < \$1M in additional funds
 High > \$1M in additional funds

Benefit / Cost***
 Low = B/C < 1
 Med = B/C 1 - 2
 High = B/C > 2

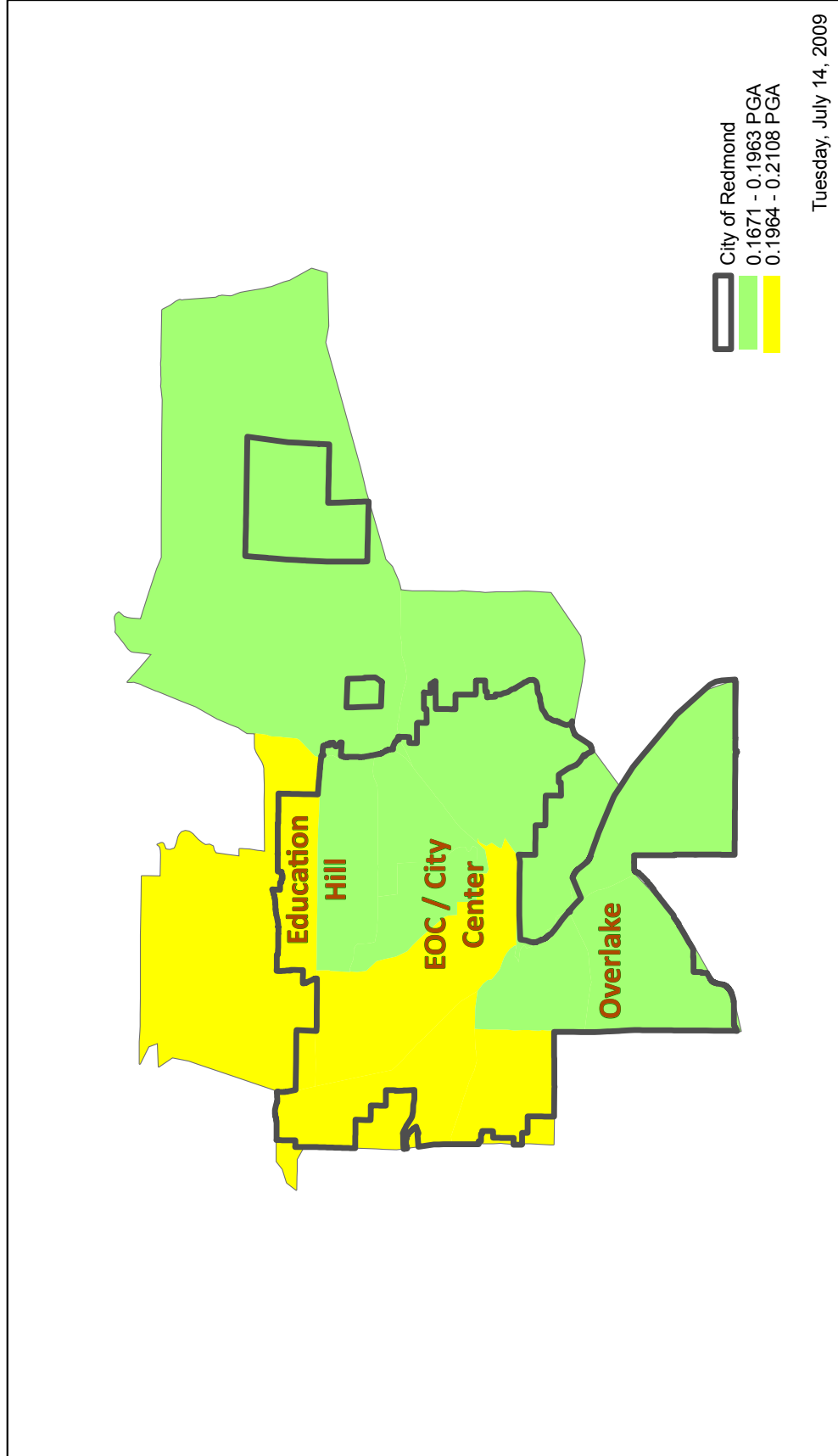
Rejected for one of the following reasons:
 (1) Not financially viable (2) City is already addressing the action item
 (3) Overlaps with another action item (4) Not feasible

Item 1: Peak Ground Acceleration for 6.7 Magnitude Seattle Fault Earthquake



Item 2: Peak Ground Acceleration for 7.1 Magnitude So. Whidbey Island Fault Earthquake

Study Region: Redmond, Washington
Hazard Scenario: South Whidbey Island Fault Crustal Earthquake, 7.1 Magnitude, Epicenter NW of Redmond



(c) 1997-2003 FEMA.



6 Miles

0

3

6

APPENDIX D: EXPOSURE ESTIMATES

Item 1: Vulnerabilities By Type of Hazard and Total Exposure Risk

Liquefaction Zone	
Vulnerability	Number
Unknown Bld type	26
Public Buildings	50
Commercial Buildings	1892
Single-Family Res	787
Multi-Family Res	203

Landslide	
Vulnerability	Number
Unknown Bld type	2
Public Buildings	1
Commercial Buildings	307
Single-Family Res	811
Multi-Family Res	65
Road Sections	516
Culverts	69

100-Year Floodplain	
Vulnerability	Number
NFIP holders	143
NFIP claims	0
Repetitive loss properties	0
Unknown Bld type	2
Public Buildings	9
Commercial Buildings	463
Single-Family Res	116
Multi-Family Res	50
Road sections	149
Culverts	79

Wildfire	
Vulnerability	Number
Public Buildings	1
Commercial Buildings	227
Single-Family Res	513
Multi-Family Res	45

Estimated Exposure Risk for City of Redmond	
Square Footage:	144,329,270
Replacement Value*:	\$3,874,830,340
Contents Value*:	2610632085
Daily Revenue Loss*:	\$2,864,414
HAZUS Total Exposure in Dollars:	\$5,459,207,000
*Estimated using formulas in FEMA 386-2, <i>State And Local Mitigation Planning How-To Series: Understanding Your Risks: Identifying Hazards and Estimating Losses</i>	

Instructions for Using the Plan Review Crosswalk for Review of Local Mitigation Plans

Attached is a Plan Review Crosswalk based on the **Multi-Hazard Mitigation Planning Guidance Under the Disaster Mitigation Act of 2000**, published by FEMA, dated March 2004. This Plan Review Crosswalk is consistent with the **Disaster Mitigation Act of 2000** (P.L. 106-390), enacted October 30, 2000 and **44 CFR Part 201 – Mitigation Planning, Interim Final Rule** (the Rule), published February 26, 2002.

SCORING SYSTEM

N – Needs Improvement: The plan does not meet the minimum for the requirement. Reviewer's comments must be provided.

S – Satisfactory: The plan meets the minimum for the requirement. Reviewer's comments are encouraged, but not required.

Each requirement includes separate elements. All elements of a requirement must be rated "Satisfactory" in order for the requirement to be fulfilled and receive a summary score of "Satisfactory." A "Needs Improvement" score on elements shaded in gray (recommended but not required) will not preclude the plan from passing.

When reviewing single jurisdiction plans, reviewers may want to put an N/A in the boxes for multi-jurisdictional plan requirements. When reviewing multi-jurisdictional plans, reviewers may want to put an N/A in the prerequisite box for single jurisdiction plans.

States that have additional requirements can add them in the appropriate sections of the **Multi-Hazard Mitigation Planning Guidance** or create a new section and modify this Plan Review Crosswalk to record the score for those requirements.

Optional matrices for assisting in the review of sections on profiling hazards, assessing vulnerability, and identifying and analyzing mitigation actions are found at the end of the Plan Review Crosswalk.

The example below illustrates how to fill in the Plan Review Crosswalk.

Example**Assessing Vulnerability: Overview**

Requirement §201.6(c)(2)(ii): *[The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE	
			N	S
A. Does the new or updated plan include an overall summary description of the jurisdiction's vulnerability to each hazard?	Section II, pp. 4-10	The plan describes the types of assets that are located within geographically defined hazard areas as well as those that would be affected by winter storms.		✓
B. Does the new or updated plan address the impact of each hazard on the jurisdiction?	Section II, pp. 10-20	The plan does not address the impact of two of the five hazards addressed in the plan. Required Revisions: <ul style="list-style-type: none"> • Include a description of the impact of floods and earthquakes on the assets. Recommended Revisions: <ul style="list-style-type: none"> • This information can be presented in terms of dollar value or percentages of damage. 	✓	
SUMMARY SCORE			✓	

June 2008

(DRAFT: Completed by the Project Team as a guide for State and FEMA review)

Local Hazard Mitigation Plan Review Crosswalk
Jurisdiction: City of Redmond

FEMA Region [Insert #]

Local Mitigation Plan Review and Approval Status

Jurisdiction: City of Redmond	Title of Plan: Hazards Mitigation Plan Update	Date of Plan: August 2009
Local Point of Contact:	Address:	
Title:		
Agency:		
Phone Number:	E-Mail:	

State Reviewer:	Title:	Date:
------------------------	---------------	--------------

FEMA Reviewer:	Title:	Date:
Date Received in FEMA Region [Insert #]		
Plan Not Approved		
Plan Approved		
Date Approved		

Jurisdiction:	NFIP Status*				CRS Class
	Y	N	N/A		
1.					
2.					
3.					
4.					
5. [ATTACH PAGE(S) WITH ADDITIONAL JURISDICTIONS]					

* Notes: Y = Participating N = Not Participating N/A = Not Mapped

June 2008

(DRAFT: Completed by the Project Team as a guide for State and FEMA review)

Local Hazard Mitigation Plan Review Crosswalk
Jurisdiction: City of Redmond

FEMA Region [Insert #]

LOCAL MITIGATION PLAN REVIEW SUMMARY

The plan cannot be approved if the plan has not been formally adopted. Each requirement includes separate elements. All elements of the requirement must be rated "Satisfactory" in order for the requirement to be fulfilled and receive a score of "Satisfactory." Elements of each requirement are listed on the following pages of the Plan Review Crosswalk. A "Needs Improvement" score on elements shaded in gray (recommended but not required) will not preclude the plan from passing. Reviewer's comments must be provided for requirements receiving a "Needs Improvement" score.

Prerequisite(s) (Check Applicable Box)

1. Adoption by the Local Governing Body: §201.6(c)(5) **OR**

NOT MET	MET

2. Multi-Jurisdictional Plan Adoption: §201.6(c)(5) **AND**

	N/A
	N/A

3. Multi-Jurisdictional Planning Participation: §201.6(a)(3)

Planning Process

4. Documentation of the Planning Process: §201.6(b) and §201.6(c)(1)

N	S
	S

Risk Assessment

5. Identifying Hazards: §201.6(c)(2)(i)

6. Profiling Hazards: §201.6(c)(2)(i)

7. Assessing Vulnerability: Overview: §201.6(c)(2)(ii)

8. Assessing Vulnerability: Addressing Repetitive Loss Properties: §201.6(c)(2)(ii)

9. Assessing Vulnerability: Identifying Structures, Infrastructure, and Critical Facilities: §201.6(c)(2)(ii)(B)

10. Assessing Vulnerability: Estimating Potential Losses: §201.6(c)(2)(ii)(B)

11. Assessing Vulnerability: Analyzing Development Trends: §201.6(c)(2)(ii)(C)

12. Multi-Jurisdictional Risk Assessment: §201.6(c)(2)(iii)

N	S
	S
	S
	S
	N/A
	S
	S
	S
	N/A

*States that have additional requirements can add them in the appropriate sections of the *Multi-Hazard Mitigation Planning Guidance* or create a new section and modify this Plan Review Crosswalk to record the score for those requirements.

June 2008

SCORING SYSTEM

Please check one of the following for each requirement.

N – Needs Improvement: The plan does not meet the minimum for the requirement.

Reviewer's comments must be provided.

S – Satisfactory: The plan meets the minimum for the requirement. Reviewer's comments are encouraged, but not required.

Mitigation Strategy

	N	S
13. Local Hazard Mitigation Goals: §201.6(c)(3)(i)		S
14. Identification and Analysis of Mitigation Actions: §201.6(c)(3)(ii)		S
15. Identification and Analysis of Mitigation Actions: NFIP Compliance, §201.6(c)(3)(ii)		S
16. Implementation of Mitigation Actions: §201.6(c)(3)(iii)		S
17. Multi-Jurisdictional Mitigation Actions: §201.6(c)(3)(iv)		N/A

Plan Maintenance Process

	N	S
18. Monitoring, Evaluating, and Updating the Plan: §201.6(c)(4)(ii)		S
19. Incorporation into Existing Planning Mechanisms: §201.6(c)(4)(ii)		S
20. Continued Public Involvement: §201.6(c)(4)(iii)		S

Additional State Requirements*

	N	S
Insert State Requirement		
Insert State Requirement		
Insert State Requirement		

LOCAL MITIGATION PLAN APPROVAL STATUS

PLAN NOT APPROVED ☐

See Reviewer's Comments

PLAN APPROVED ☐

(DRAFT: Completed by the Project Team as a guide for State and FEMA review)

PREREQUISITE(S)

1. Adoption by the Local Governing Body

Requirement §201.6(c)(5): [The local hazard mitigation plan **shall** include] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commissioner, Tribal Council).

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE	
			NOT MET	MET
A. Has the local governing body adopted new or updated plan?		The local governing body is prepared to adopt the plan upon State and FEMA approval		
B. Is supporting documentation, such as a resolution, included?		A sample of the resolution is included		
SUMMARY SCORE				

2. Multi-Jurisdictional Plan Adoption

Requirement §201.6(c)(5): For multi-jurisdictional plans, each jurisdiction requesting approval of the plan **must** document that it has been formally adopted.

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE	
			NOT MET	MET
A. Does the new or updated plan indicate the specific jurisdictions represented in the plan?	N/A			
B. For each jurisdiction, has the local governing body adopted the new or updated plan?	N/A			
C. Is supporting documentation, such as a resolution, included for each participating jurisdiction?	N/A			
SUMMARY SCORE				

3. Multi-Jurisdictional Planning Participation

Requirement §201.6(a)(3): Multi-jurisdictional plans (e.g., watershed plans) may be accepted, as appropriate, as long as each jurisdiction has participated in the process ... Statewide plans will not be accepted as multi-jurisdictional plans.

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE	
			NOT MET	MET
A. Does the new or updated plan describe how each jurisdiction participated in the plan's development?	N/A			
B. Does the updated plan identify all participating jurisdictions, including new, continuing, and the jurisdictions that no longer participate in the plan?	N/A			
SUMMARY SCORE				

(DRAFT: Completed by the Project Team as a guide for State and FEMA review)

PLANNING PROCESS: §201.6(b): *An open public involvement process is essential to the development of an effective plan.*

4. Documentation of the Planning Process

Requirement §201.6(b): *In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process **shall** include:*

- (1) *An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;*
- (2) *An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and*
- (3) *Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.*

Requirement §201.6(c)(1): *[The plan **shall** document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE	
			N	S
A. Does the plan provide a narrative description of the process followed to prepare the new or updated plan?	Part 2, Chapter 3 (pp. 33-42)			
B. Does the new or updated plan indicate who was involved in the current planning process? (For example, who led the development at the staff level and were there any external contributors such as contractors? Who participated on the plan committee, provided information, reviewed drafts, etc.?)	List of Contributors, Part 2, Chapter 3 (pp.i, 33-42)			
C. Does the new or updated plan indicate how the public was involved? (Was the public provided an opportunity to comment on the plan during the drafting stage and prior to the plan approval?)	Part 2, Chapter 3.2 (pp. 34-36)			
D. Does the new or updated plan discuss the opportunity for neighboring communities, agencies, businesses, academia, nonprofits, and other interested parties to be involved in the planning process?	Part 2, Chapter 3 (pp. 33-42)			
E. Does the planning process describe the review and incorporation, if appropriate, of existing plans, studies, reports, and technical information?	Part 1, Chapter 1 (pp. 5-6, 11)			
F. Does the updated plan document how the planning team reviewed and analyzed each section of the plan and whether each section was revised as part of the update process?	Throughout			
SUMMARY SCORE				

(DRAFT: Completed by the Project Team as a guide for State and FEMA review)

RISK ASSESSMENT: §201.6(c)(2): *The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.*

5. Identifying Hazards

Requirement §201.6(c)(2)(i): *[The risk assessment shall include a] description of the type ... of all natural hazards that can affect the jurisdiction.*

Element	Location in the Plan (section or annex and page #)		Reviewer's Comments	SCORE	
	N	S		N	S
A. Does the new or updated plan include a description of the types of all natural hazards that affect the jurisdiction?	Part 3 (pp. 51, 61, 75, 93, 101, 111, 119, 123, 129)		The first part of each Chapter in Part 3 identifies and describes a natural hazard that affects the jurisdiction.		
SUMMARY SCORE					

6. Profiling Hazards

Requirement §201.6(c)(2)(i): *[The risk assessment shall include a] description of the ... location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.*

Element	Location in the Plan (section or annex and page #)		Reviewer's Comments	SCORE	
	N	S		N	S
A. Does the risk assessment identify the location (i.e., geographic area affected) of each natural hazard addressed in the new or updated plan?	Part 3 (pp. 52, 62-66, 76, 94, 102, 113, 119, 125, 009)				
B. Does the risk assessment identify the extent (i.e., magnitude or severity) of each hazard addressed in the new or updated plan?	Part 3 (pp. 52, 62-66, 76, 94, 102, 113, 119, 125, 009)				
C. Does the plan provide information on previous occurrences of each hazard addressed in the new or updated plan?	Part 3 (pp. 52, 62-66, 76, 94, 102, 113, 119, 125, 009)				
D. Does the plan include the probability of future events (i.e., chance of occurrence) for each hazard addressed in the new or updated plan?	Part 3 (pp. 52, 62-66, 76, 94, 102, 113, 119, 125, 009)				
SUMMARY SCORE					

(DRAFT: Completed by the Project Team as a guide for State and FEMA review)

7. Assessing Vulnerability: Overview

Requirement §201.6(c)(2)(ii): [The risk assessment **shall** include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description **shall** include an overall summary of each hazard and its impact on the community.

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE	
			N	S
A. Does the new or updated plan include an overall summary description of the jurisdiction's vulnerability to each hazard?	Part 3 (pp. 63, 67, 79, 95, 103, 115, 120, 127, 131)			
B. Does the new or updated plan address the impact of each hazard on the jurisdiction?	Part 3 (pp. 63, 67, 79, 95, 103, 115, 120, 127, 131)			
SUMMARY SCORE				

8. Assessing Vulnerability: Addressing Repetitive Loss Properties

Requirement §201.6(c)(2)(ii): [The risk assessment] **must** also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE	
			N	S
A. Does the new or updated plan describe vulnerability in terms of the types and numbers of repetitive loss properties located in the identified hazard areas?	Part 3, Chapter 6 (pp. 75-82)	There are none repetitive loss properties in Redmond.		
SUMMARY SCORE				

9. Assessing Vulnerability: Identifying Structures

Requirement §201.6(c)(2)(ii)(A): The plan **should** describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE	
			N	S
A. Does the new or updated plan describe vulnerability in terms of the types and numbers of existing buildings, infrastructure, and critical facilities located in the identified hazard areas?	Part 3 Chapters X.3; Appendix D (pp. 181)	Exposure numbers are included in the risk assessment.		

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B. Does the new or updated plan describe vulnerability in terms of the types and numbers of future buildings, infrastructure, and critical facilities located in the identified hazard areas?	Part 3 and Part 4 (Strategy 2 pp.142-143)	This plan addresses the need for facilities outside of the hazard areas		
SUMMARY SCORE				

10. Assessing Vulnerability: Estimating Potential Losses

Requirement §201.6(c)(2)(ii)(B): *[The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate ...*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE	
			N	S
A. Does the new or updated plan estimate potential dollar losses to vulnerable structures?	Part 3, Chapter 5 (pp.71); Appendix D (pp. 181)	Information about potential dollar losses from an earthquake is described in Chapter 5		
B. Does the new or updated plan describe the methodology used to prepare the estimate?	Part 3, Chapter 5 (pp. 71)	Chapter 5 estimates for dollar losses were based on HAZUS.		
SUMMARY SCORE				

11. Assessing Vulnerability: Analyzing Development Trends

Requirement §201.6(c)(2)(ii)(C): *[The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE	
			N	S
A. Does the new or updated plan describe land uses and development trends?	Part 3 (each Chapter)	Each hazard explains the interaction between development trends and potential vulnerabilities		
SUMMARY SCORE				

12. Multi-Jurisdictional Risk Assessment

Requirement §201.6(c)(2)(iii): *For multi-jurisdictional plans, the risk assessment **must** assess each jurisdiction's risks where they vary from the risks facing the entire planning area.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE	
			N	S
A. Does the new or updated plan include a risk assessment for each participating jurisdiction as needed to reflect unique or varied risks?	N/A			

(DRAFT: Completed by the Project Team as a guide for State and FEMA review)

SUMMARY SCORE		
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MITIGATION STRATEGY: § 201.6(c)(3): The plan shall include a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.

13. Local Hazard Mitigation Goals

Requirement §201.6(c)(3)(i): [The hazard mitigation strategy **shall** include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE	
			N	S
A Does the new or updated plan include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards?	Part 4, Chapter 13.2 (pp. 136)			
SUMMARY SCORE				

14. Identification and Analysis of Mitigation Actions

Requirement §201.6(c)(3)(ii): [The mitigation strategy **shall** include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE	
			N	S
A. Does the new or updated plan identify and analyze a comprehensive range of specific mitigation actions and projects for each hazard?	Part 4, Chapter 13 (pp. 135-149) and Appendix B (pp. 172-178)	Appendix B goes over the comprehensive range of actions, Chapter 13 details the selected actions		
B Do the identified actions and projects address reducing the effects of hazards on new buildings and infrastructure?	Part 4, Chapter 13 (pp. 135-149)			
C. Do the identified actions and projects address reducing the effects of hazards on existing buildings and infrastructure?	Part 4, Chapter 13 (pp. 135-149)			
SUMMARY SCORE				

15. Identification and Analysis of Mitigation Actions: National Flood Insurance Program (NFIP) Compliance

Requirement: §201.6(c)(3)(ii): [The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program (NFIP), and continued compliance with NFIP requirements, as appropriate.

(DRAFT: Completed by the Project Team as a guide for State and FEMA review)

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE	
			N	S
A. Does the new or updated plan describe the jurisdiction (s) participation in the NFIP?	Part 3, Chapter 6 (pp.76-77)			
B. Does the mitigation strategy identify actions related to participation in and continued compliance with the NFIP?	Part 4, Chapter 13, Strategy 6 (pp. 149)			
SUMMARY SCORE				

16. Implementation of Mitigation Actions

Requirement: §201.6(c)(3)(iii): [The mitigation strategy section **shall** include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization **shall** include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE	
			N	S
A. Does the new or updated mitigation strategy include how the actions are prioritized? (For example, is there a discussion of the process and criteria used?)	Part 4 (pp. 129-139)			
B. Does the new or updated mitigation strategy address how the actions will be implemented and administered, including the identification of the department responsible for implementing each action, existing and potential resources for each action and the timeframe for completion of each action?	Part 4, Chapter 13.5 (pp. 139-150)	See the charts for each of the strategies.		
C. Does the new or updated prioritization process include an emphasis on the use of a cost-benefit review to maximize benefits?	Part 4, Chapter 13.4 (pp. 138) and Appendix B (pp. 172-178)	Chapter 13.4 explains the process and Appendix B shows the Benefit-cost charts		
SUMMARY SCORE				

17. Multi-Jurisdictional Mitigation Actions

Requirement §201.6(c)(3)(iv): For multi-jurisdictional plans, there **must** be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan.

Location in the	SCORE
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(DRAFT: Completed by the Project Team as a guide for State and FEMA review)

Element	Plan (section or annex and page #)	Reviewer's Comments	N	S
A. Does the new or updated plan include identifiable action items for each jurisdiction requesting FEMA approval of the plan?	N/A			
B. Does the new or updated mitigation strategy address how the actions will be implemented and administered, including the identification of the department responsible for implementing each action, existing and potential resources for each action and the timeframe for completion of each action?	N/A			
SUMMARY SCORE				

PLAN MAINTENANCE PROCESS

18. Monitoring, Evaluating, and Updating the Plan

Requirement §201.6(c)(4)(ii): [The plan maintenance process **shall** include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE	
			N	S
A. Does the new or updated plan describe the method and schedule for monitoring the plan, including the responsible department and other methods or schedules?	Part 5, Chapter 14.1 (pp. 151)			
B. Does the new or updated plan describe the method and schedule for evaluating the plan, including the responsible department and the criteria used to evaluate the plan?	Part 5, Chapter 14.1 (pp. 151)			
C. Does the new or updated plan describe the method and schedule for updating the plan within the five-year cycle?	Part 5, Chapter 14.1 (pp. 151)			
SUMMARY SCORE				

19. Incorporation into Existing Planning Mechanisms

Requirement §201.6(c)(4)(ii): [The plan **shall** include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE	
			N	S

(DRAFT: Completed by the Project Team as a guide for State and FEMA review)

A. Does the new or updated plan identify other local planning mechanisms available for incorporating the mitigation requirements of the mitigation plan?	Part 5, Chapter 14.2 (pp. 152-154)		
B. Does the new or updated plan include a process by which the local government will incorporate the mitigation strategy and other planning mechanisms, when appropriate?	Part 5, Chapter 14.2 (pp. 152-154)		
C. Does the updated plan explain how the local government incorporated the mitigation strategy into other planning mechanisms, when appropriate?	Part 5, Chapter 14.2 (pp. 152-154)		
SUMMARY SCORE			

Continued Public Involvement

Requirement §201.6(c)(4)(iii): *[The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE	
			N	S
A. Does the new or updated plan explain how continued public participation will be obtained? (For example, will there be public notices, an on-going mitigation plan committee, or annual review meetings with stakeholders?)	Part 5, Chapter 14.3 (pp. 154)			
SUMMARY SCORE				

Matrix A: Profiling Hazards

This matrix can assist FEMA and the State in scoring each hazard. Local jurisdictions may find the matrix useful to ensure that their plan addresses each natural hazard that can affect the jurisdiction. **Completing the matrix is not required.**

Note: First, check which hazards are identified in requirement §201.6(c)(2)(i). Then, place a checkmark in either the N or S box for each applicable hazard. An "N" for any element of any identified hazard will result in a "Needs Improvement" score for this requirement. List the hazard and its related shortcoming in the comments section of the Plan Review Crosswalk.



Hazard Type	Hazards Identified Per Requirement §201.6(c)(2)(i)		A. Location		B. Extent		C. Previous Occurrences		D. Probability of Future Events	
	Yes	No	N	S	N	S	N	S	N	S
Avalanche	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Coastal Erosion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Coastal Storm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dam Failure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Drought	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Earthquake	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Expansive Soils	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Levee Failure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Flood	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Hailstorm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hurricane	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Land Subsidence	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Landslide	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Severe Winter Storm	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Tornado	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tsunami	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Volcano	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Wildfire	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Windstorm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Legend:

§201.6(c)(2)(i) Profiling Hazards

A. Does the risk assessment identify the location (i.e., geographic area affected) of each hazard addressed in the **new or updated** plan?

B. Does the risk assessment identify the extent (i.e., magnitude or severity) of each hazard addressed in the **new or updated** plan?

C. Does the plan provide information on previous occurrences of each natural hazard addressed in the **new or updated** plan?

Appendix

Matrix B: Assessing Vulnerability

This matrix can assist FEMA and the State in scoring each hazard. Local jurisdictions may find the matrix useful to ensure that the new or updated plan addresses each requirement. **Completing the matrix is not required.**

Note: Receiving an N in the shaded columns will not preclude the plan from passing.

To check boxes, double click on the box and change the default value to "checked "

Legend:

\$201.6(c)(2)(ii) Assessing Vulnerability: Overview

A. Does the **new or updated** plan include an overall summary description of the jurisdiction's vulnerability to each hazard?

B. Does the **new or updated** plan address the impact of each hazard on the jurisdiction?

B. Does the **new or updated** plan describe vulnerability in terms of the types and numbers of future buildings, infrastructure, and critical facilities located in the identified hazard areas?

\$201.6(c)(2)(ii)(B) Assessing Vulnerability: Estimating Potential Losses

(DRAFT: Completed by the Project Team as a guide for State and FEMA review)

§201.6(c)(2)(ii)(A) Assessing Vulnerability: Identifying Structures

- A. Does the **new or updated** plan describe vulnerability in terms of the types and numbers of existing buildings, infrastructure, and critical facilities located in the identified hazard areas?

- A. Does the **new or updated** plan estimate potential dollar losses to vulnerable structures?
B. Does the **new or updated** plan describe the methodology used to prepare the estimate?

Matrix C: Identification and Analysis of Mitigation Actions

This matrix can assist FEMA and the State in scoring each hazard. Local jurisdictions may find the matrix useful to ensure consideration of a range of actions for each hazard. **Completing the matrix is not required.**

*Note: First, check which hazards are identified in requirement §201.6(c)(2)(i). Then, place a checkmark in either the N or S box for each **applicable** hazard. An "N" for any identified hazard will result in a "Needs Improvement" score for this requirement. List the hazard and its related shortcoming in the comments section of the Plan Review Crosswalk.*



Hazard Type	Hazards Identified Per Requirement §201.6(c)(2)(i) Yes	A. Comprehensive Range of Actions and Projects		
		N	S	
Avalanche	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Coastal Erosion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Coastal Storm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Dam Failure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Drought	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Earthquake	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Expansive Soils	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Levee Failure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Flood	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Hailstorm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Hurricane	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Land Subsidence	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Landslide	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Severe Winter Storm	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Tornado	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Tsunami	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Volcano	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Wildfire	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Windstorm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Legend:

§201.6(c)(3)(ii) Identification and Analysis of Mitigation Actions

- A. Does the **new or updated** plan identify and analyze a comprehensive range of specific mitigation actions and projects for each hazard?

2009 Redmond Recovery Plan

July 28th, 2009



Department of Urban Design & Planning
COLLEGE OF BUILT ENVIRONMENTS
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Sources included on the Reference page were all used to compile the information, recommendation, and structure of this Plan. They are not cited specifically, as several or all sources provided the same or similar information; nearly every line would have multiple sources cited.

When specific text or charts were used, footnotes and page numbers are included.

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Executive Summary

Recovery Planning is a part of Emergency Management Planning. In the event of a hazard, the City of Redmond will be working to recover to a state that is superior to pre-disaster conditions. This plan provides guidance for the City to be able to perform at optimal functionality in the chaotic post-disaster period. The ultimate goal of recovery is to restore all necessary City functions, while making Redmond more resilient to future hazards events.

This Recovery Plan considers three potential hazards events that could impact the City of Redmond. Various levels of recovery will be necessary depending on the type of disaster and the extent of the damage. The scenarios lay out a minor event, a major event and a catastrophic event. This Plan also evaluates which secondary hazards are likely to accompany a primary hazard and how that may impact the potential for recovery.

History and science guide our understanding of which hazards pose a threat to the City of Redmond; however, the threat, timing and precise conditions are unknown variables. Since it is impossible to predict the specific impacts of such an event, it is futile to make precise plans for the multitude of potential events. This Plan suggests guidelines for action and flexible decision making that can be coordinated with state, regional and federal assistance.

In the event of a hazard, the City must be prepared to designate a Recovery Manager, delegate tasks and potentially lead efforts from an alternative location. This Plan explains the likely conditions and how authority should be delegated. Due to the uncertainty with hazards and the potential for City employees to be unavailable, this plan sets parameters by which the recovery can be flexible to adapt to the specifics of the situation.

There are two types of recovery – short-term restoration of services and long-term enhancement of the City services and economic potential. This plan suggests how the City can consider the long-term impacts of short-term solutions.

By considering the impacts of hazards prior to an event and preparing how the City will respond to such an event, Redmond will be able to implement an effective, inclusive recovery plan that will make the City more resilient to future hazards events. Through pre-disaster planning, Redmond will be able to go beyond merely restoring services to their previous condition and advance the City through implementing long term plans at an accelerated pace.

I. Introduction

Purpose

The purpose of this plan is to prepare for and guide recovery efforts after a disaster, in order to make the most of available resources and avoid costly administrative mistakes that can occur during a difficult and chaotic period. Such planning will relieve pressure on City staff immediately after a hazards event so that they may provide the highest level of service to the citizens of Redmond.

Scope

This plan includes the following:

- The type and scale of disasters that may require recovery
- The authorities guiding these efforts.
- The responsibilities of different departments for disaster recovery.
- How to anticipate possible secondary hazards based on the primary event and the correlating impact on recovery.
- Explanation of the phases and timeline of recovery.
- Operations and management of recovery effort.
- Three hazards scenarios to clarify procedures and considerations for different types of disasters.

This plan does not include:

- Information regarding terrorism, biological weapons or other man-made disasters. These situations are covered in the Redmond Terrorism Plan.
- Sample forms, letters, ordinances or other documents. Several examples are available in the FEMA *Recovery From Disaster: Local Government Role Toolkit*, available in the Emergency Manager's Office.
- Detailed hazard or risk analysis. This is included in the 2009 Redmond Hazard Mitigation Plan (HMP).

Plan Reviews and Updates

The recovery plan shall be updated at least every five years, during the HMP update. Updates shall take into account changes in vulnerabilities, growth, and address emerging issues. It is recommended that it be reviewed yearly to ensure that referenced documents are still available or accurate. Annual review should be coordinated with staff training.

II. Policies

Recovery Activities

- Recovery activities begin simultaneously with many response activities. Initial recovery will include **restoration of vital services**.
- **Data collection** During the primary and secondary estimations of damages, the use of a specific form or coordinating language can jumpstart the reimbursement process for faster, more efficient recovery.
- State or Federal disaster declarations make a variety of **assistance available**, and thus data collected should be organized in a way compatible with these programs. If Federal or State declarations are not sought, other assistance programs make use of the same information.

Catastrophic Disasters

- **Coordination with State and federal agencies:** In the event of a catastrophic disaster, all city staff will be working closely with State, Federal, and possibly private representatives, teams and task forces to aid in response and recovery. Information sharing and full cooperation must be prioritized to avoid miscommunication or lost opportunities.
- **Long-term recovery management:** In the event of a catastrophic event or one that requires long-term recovery planning and management, the Mayor may choose to appoint a Recovery Manager to oversee the process and free the Emergency Manager to concentrate on responding to subsequent events.
- Scenarios and further information regarding Catastrophic Disasters and the Recovery Manager position can be found in Appendices I and IV.

Events Involving Terrorism or Bioterrorism

The Redmond Terrorism Plan is the primary source for information regarding incidents of terrorism or bioterrorism. Considerations related to secondary hazards from terrorist events, if not explicitly outlined in that plan, should borrow from or follow this Recovery plan whenever appropriate.

Assignment of Responsibilities

Responsibilities for emergency management as stated in the CEMP for the response, preparation or mitigation phases may be slightly different than those for recovery. This plan includes the roles recommended only during the recovery process.

III. Situation

Emergency/Disaster Conditions and Hazards

A primary event, such as an earthquake, can trigger a number of secondary hazards such as landslides and fires. The Secondary Hazards Matrix on Page 13 outlines the types of secondary hazards that are very likely, somewhat likely, or unlikely to occur following a primary event. Consider multiple hazard scenarios when reopening areas, rebuilding, or applying for recovery funds.

Appendices II through V outline scenarios for three levels of disasters: minor, major, and catastrophic. For the purposes of this plan, they are defined as follows:

Minor disaster: the event is localized, there are few deaths or major injuries, and recovery efforts will only affect a specific area and a small segment of the population. Recovery or repairs will be overseen by only one or two departments and will take less than one year.

Major disaster: the event is widespread or occurs over a large area, or affects multiple segments of the population. There may be several deaths or injuries, or none. Damage is mild to moderate, and major city functions are disrupted for less than a week. Several departments are affected, and recovery or repairs are estimated to take several months to a few years. Disaster declarations may be sought.

Catastrophic disaster: the event impacts most or all of the city and may be regional in nature. There are likely several injuries and at least some deaths. Damage is moderate to severe in multiple areas. Major city functions are disrupted for more than one week. Recovery or repairs are estimated to take several years. A disaster declaration is sought and granted.

The level and type of disaster will vary the types of recovery considerations and actions taken. The scenarios in the Appendices are intended only to clarify the types of situations that may trigger certain actions recommended in this plan; they are not designed to be predictive in nature or imply the likelihood of a particular situation occurring.

Natural Hazards Identification

The 2009 Redmond Hazards Mitigation Plan (HMP) provides detailed information about the natural hazards that pose a threat to the City of Redmond.

Part 2 of the HMP details the vulnerabilities, risks and capabilities in the City of Redmond.

Part 3 of the HMP includes descriptions of the types of natural hazards.

Planning Assumptions

In order to prepare for recovery activities, this plan makes several assumptions. These assumptions provide a forecast of the likely conditions after an event.

- An emergency or disaster has occurred. Actions to implement this plan will begin before emergency conditions subside.¹
- The emergency or disaster has caused significant damage so as to require recovery activities. These damages may have caused the loss of life support systems and the loss of regional economic, physical, and social infrastructures.²
- Not all members of the Mitigation Implementation Committee (MIC), response

1,2 Text taken directly from Section III D of the 1999 Washington State Recovery Plan Coordinating Draft, Washington State Military Department Emergency Management Division, p7.

personnel, City staff or private contractors may be available during or after the event. They, their families, or their friends may be directly affected by the event and in need of aid.

- Unincorporated areas or other cities nearby may be competing for the same resources needed by affected Redmond citizens.
- Other cities in King County or Washington State may be affected by the disaster and not able to provide assistance or access to their facilities.

IV. Concept of Operations

Recovery Manager

When the recovery process is expected to involve several projects or take more than a few months, the Mayor shall appoint a Recovery manager. The Recovery Manager oversees the recovery process. His/her principle mission is to select appropriate projects that will benefit the community and to ensure those projects are completed in a timely and efficient manner. Additional tasks may include selecting projects to complete, or coordinating projects between departments and external agencies to avoid conflicts, overlap, or interference.

Information about when and how to appoint a Recovery Manager and additional duties are detailed in Appendix I.

Direction and Control

Recovery will be an inter-agency activity. Redmond has established the Mitigation Implementation Committee (MIC), which is comprised of members from several departments. The MIC reviews HMP process and is familiar with the stakeholders, hazards and potential damage in the City of Redmond. The MIC will continue to meet, review items regarding preparation and mitigation, and organize training drills. In the event of a disaster, the MIC will function as the steering committee for recovery operations. Depending on the level of damage and projected extent of recovery, the MIC may require additional assistance to direct the efforts. To accommodate the long-term recovery needs, the MIC will either advise the Mayor's Office on, or select, and train the new staff. Additional staff or consultants may be required for extensive recovery.

The MIC, or any Recovery Team or Task Force shall consist of members from the following departments:

Required MIC representatives
Department of Parks
Police Department
Planning and Development Services
Public Works
Information Services/Finance
Geographic Information Systems (GIS)
Fire Department
Emergency Management
Chief Information Officer (see Appendix I)
Additional members may include
Consultants as necessary
Volunteer or aid groups
Federal and State representatives
Members of organized citizen or business groups

Recovery and Support Structure

Federally declared disasters make several types of recovery funds available, and should be utilized to their full extent. Post-disaster data collection should be compatible with the requirements for federal assistance. Additionally, the City shall assist residents with individual claims and how to properly document all activities that are covered under public assistance. Details of the types of assistance available and the agency in charge are found in Appendix C of *Planning for Post-Disaster Recovery and Reconstruction*.

V. Responsibilities

The following list of responsibilities are intended to clarify the roles during the recovery process. The MIC may decide that roles should be reassigned based on the situation, and that should be followed as long as all tasks are fully staffed.

Some of the responsibilities may not be needed, depending on the type, scale and location of the event; however this must be agreed upon by the MIC and Recovery Manager, rather than by the department to which it has been assigned.

The check marks on the left indicate whether the activity is conducted before a hazards event, during short-term or long-term recovery, or a combination of the three.

✓ **Pre-event** ✓ **Short-term Recovery** ✓ **Long-term Recovery**

Mayor's Office

- ✓ ✓ ✓ **Communicate with all departments** immediately during/after a disaster and gather preliminary damage reports to determine whether or not a disaster declaration should be made and further assistance requested from the State and/or Federal government
- ✓ ✓ ✓ **Appoint a Chief Information Officer** to organize communication and set up an Information Center, if appropriate
- ✓ ✓ ✓ **Appoint a Recovery Manager** if long-term recovery is required

Finance and Information Services

- ✓ ✓ ✓ Provide staffing support or assign staff to research and apply for **recovery funds** and programs for public and individual assistance
- ✓ ✓ ✓ **Determine the amount of funds available** for low or no-interest loans to community members and businesses after a disaster, and administer the program
- ✓ ✓ ✓ **Train volunteers** to perform the services above, if available
- ✓ ✓ ✓ **Provide staff**, resources and support to information fairs, hotlines, or neighborhood programs to educate citizens about their financial options following a disaster, and in filling out the forms if needed.
- ✓ ✓ ✓ **Provide staff** for the Information Center and offer CIO candidates.
- ✓ ✓ ✓ **Ensure forms and language** used for damage estimation, payroll tracking, and other expenditures during a disaster are compatible with State and Federal compensation programs.

Fire Department

- ✓ **Train first responders** in damage assessment and proper measurement systems and terminology use on forms to assist in disaster declaration requirements and/or recovery fund applications
- ✓ **Provide feedback** to the MIC during planning regarding safety issues (e.g. road maneuverability, drought-resistant vegetation)

Emergency Management

- ✓ ✓ Manage **immediate response** actions, e.g. evacuation or identifying shelters
- ✓ ✓ **Coordinate** with relief agencies (Red Cross, faith organizations)

- ✓ Provide documents, direction, and contacts to all other departments during the recovery process
- ✓ Work with the building manager **to establish reconstruction priorities**
- ✓ Offer **general information** to recovery plan drafters regarding evacuation needs and other applicable concerns
- ✓ Provide **write-ups of disaster response and lessons learned** to inform the recovery plan

Planning and Community Development

- ✓ Assist with the **identification** of appropriate sites for **redundant operations** centers
- ✓ Identify a number of possible **shelter and temporary housing locations**
- ✓ Create an **Old Town Recovery Plan**
- ✓ Provide staff and support to the historic preservation team to oversee and implement the Old Town Recovery Plan
- ✓ **Work with nearby municipalities** to coordinate temporary housing in the event of a large-scale or regional event
- ✓ **Assist the Information Center** and the FIS with informing and providing support to the public regarding financial assistance options
- ✓ Assist with damage assessment, particularly **mapping of data** to prepare for the planning process
- ✓ Work with emergency management and damage assessment teams to **identify construction moratorium areas**
- ✓ Enact a **moratorium on building permits** during the recovery phase to allow for the planning process
- ✓ Be the lead agency for the post-disaster **public revisioning process**
- ✓ Assist with determining **traffic flow** patterns and needs to prioritize road closures and repairs
- ✓ Review **building permit and repair applications** for consistency with the Comprehensive Plan, the Hazard Mitigation Plan, and any Recovery Plans that are created after the event
- ✓ **Reevaluate and update the Recovery Plan** with new information at least every five years, preferably alongside the Hazard Mitigation Plan updates, or if deemed necessary following a major change or event

Public Works

- ✓ Train selected Public Works employees in **damage assessment** and be prepared to activate those employees in case of an event

- ✓ ✓ **Identify private contractors** to assist in damage assessment or emergency repair and recommend they be given pre-existing contracts to be activated immediately following an event
- ✓ Create a **training program** for first responders, volunteers or city staff in **damage assessment**
- ✓ ✓ Be the lead agency in any **debris removal plans**
- ✓ Be the lead agency in any **toxic cleanup activities**
- ✓ ✓ Support replanning activities with data and feedback on **infrastructure needs and transportation repair**
- ✓ ✓ Support, **provide feedback** about, and implement transportation repairs and restoration

Geographic Information Systems

- ✓ ✓ ✓ **Update** GIS database in a manner that is compatible with HAZUS.
- ✓ ✓ ✓ Create efficient **data collection procedures** that can be implemented to assess damage.
- ✓ ✓ ✓ **Prepare maps** and spatial analysis of hazards impact
- ✓ ✓ Give feedback to FEMA to provide improved information for the next event

Parks and Recreation










- ✓ **Maintain infrastructure** in parks in case of the need for mass shelters (particularly running water, electricity and restrooms)
- ✓ Work with Planning Department to **identify shelter and distribution center** locations
- ✓ ✓ **Provide staff and supplies** to emergency shelters on park land

Human Resources

- ✓ **Offer classes** in working with and training volunteers to all departments
- ✓ ✓ ✓ **Support volunteer training** by departments by providing supplies, meeting areas, and staff if necessary
- ✓ ✓ **Organize and manage volunteer center** to identify and assign the skill sets of volunteers and manage paperwork
- ✓ ✓ **Support Financial Services** with tracking overtime and other emergency expenses for future reimbursement

Police

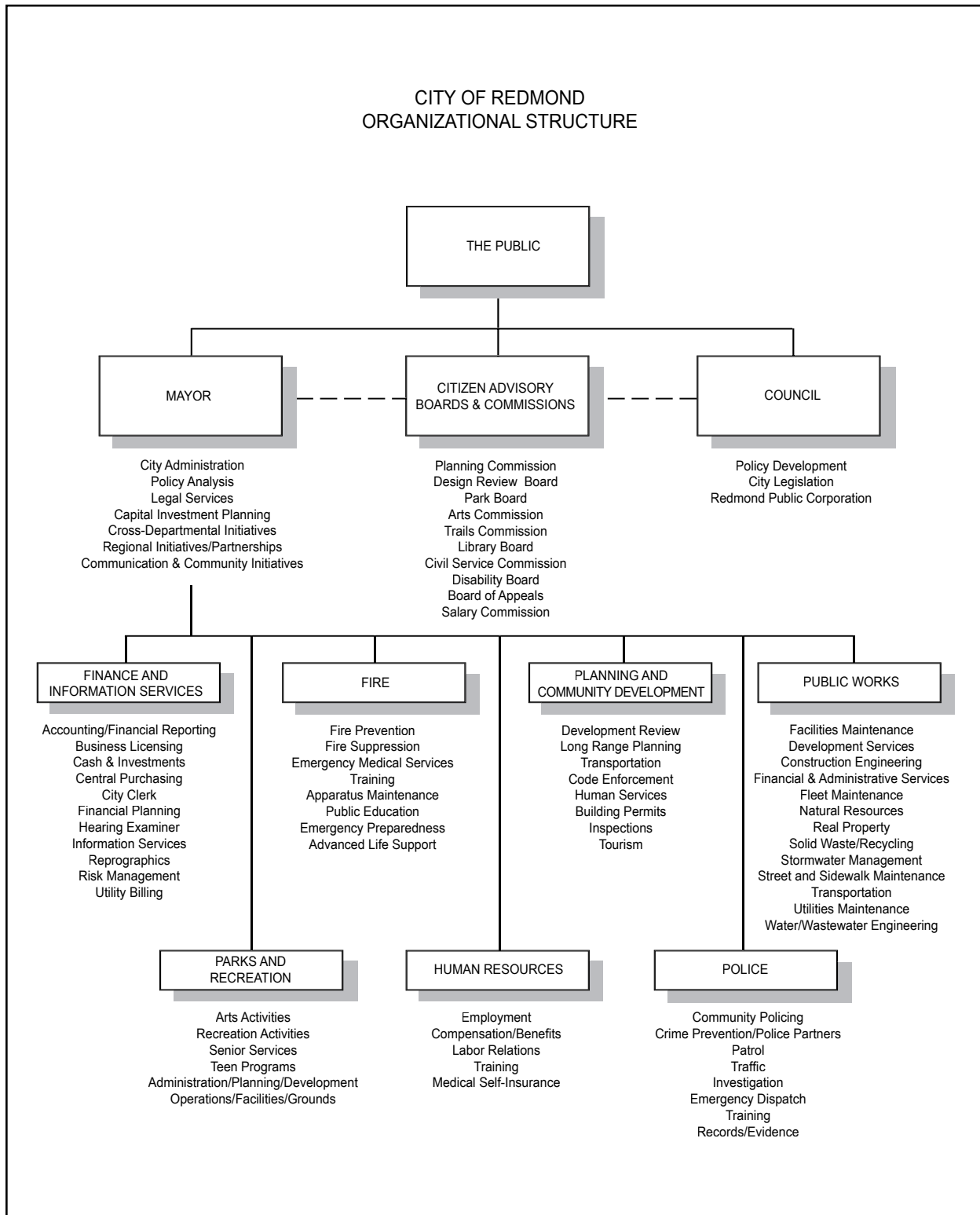
- ✓ **First responders** immediately after an event (search and rescue, medical care, emergency transport)

-  Implement any **curfews** declared after an event
-  **Support damage assessment** by informing crews of areas or infrastructure that requires investigation
-   **Provide information to citizens** in the field about recovery support options (i.e. location and contact information for shelters and financial assistance)
-   **Provide staff support to emergency management**, transit and public works officials to prevent re-entry into dangerous areas or during reconstruction
-    **Provide feedback** to recovery planners about response needs or safety issues specific to a community or area

Responsibility matrix³

Function	Mayor	FIS	Fire	PCD	PW	P&R	HR	Police
Response/Early Recovery								
Evacuation			X					X
Urban Search and Rescue			X					X
Emergency Shelter Provisions			X	X		X		
Mass Care (food, water, medicine)	X		X	X				X
Organization and Authority								
Empower Recovery Task Force	X							
Designate Lead Agency	X							
Operations Policy	X							
Set Up Disaster Accounting Systems	X	X					X	
Coordinate With Emergency Manager	X		X	X				
Public Participation and Hearings				X				
Rehabilitative								
Temporary Housing				X	X			
Refuse Disposal					X			
Damage Assessment	X			X	X			
Restoration of Utility Services					X			
Establish Reconstruction Priorities	X		X	X				X
Reoccupancy Permits			X	X				X
Emergency Demolition	X			X				
Emergency Permitting	X							
Loan Processing		X		X				
Toxic Cleanup					X			
Land Use								
Identify Sites for Emergency Operations				X	X			
Identify New Lessons			X	X	X			
Compliance With Regulations From Lessons			X	X				
Replanning of Stricken Areas			X	X	X	X		X
Reexamine Street Patterns for Access	X		X	X	X			
Feasibility of Emergency Evacuation			X	X	X			X
Historic Preservation				X				
Implement Area Building Moratoria	X			X				
Reevaluation and Update of Plan	X		X	X				
Regional Coordination								
Coordination With Relief Agencies			X					
Temporary Housing				X				
Financial Assistance Channels	X	X		X				
Transportation Repairs/Restoration			X		X			X
Emergency Legislation	X							
Media Contact	X	X						
Mutual Aid Agreements	X		X		X			X
FIS = Finance and Information Services PCD = Planning and Community Development PW = Public Works P&R = Parks and Rec HR = Human Resources								

³ Adapted from *Planning for Post-Disaster Recovery and Reconstruction*, American Planning Association, 1998, pp. 91-92.

City of Redmond Organizational Structure chart⁴

⁴ Chart from City of Redmond 2008-2009 Budget, <http://www.redmond.gov/insidecityhall/finance/budget/0708AdoptedPdfs/05-CORorgchart.pdf>

Secondary Hazards Matrix⁵

PRIMARY HAZARDS										Secondary Hazards Matrix	
										<div> <div> <div></div> <div></div> <div></div> </div> <div> <div>Very Likely</div> <div>Possible</div> <div>Unlikely</div> </div> </div> <div> <div>Legend</div> </div>	
										POSSIBLE COROLLARY IMPACTS:	
A. Natural Hazards											
Earthquake										Explosion	
Flood										Flood/Urban Flood	
Landslide										Landslide	
Severe Storm										Mud/Rock Flow: Ash	
Drought										Nuclear Event	
Volcano (Ash/Regional)										Wildfire	
Wildfire										Seiche	
B. Operational Hazards											
Domestic Water Systems										Domestic Water	
Power Outage										Power Outage	
Communication System										Communication System	
HVAC										HVAC	
Trouble/Fire Alarm										Trouble/Fire Alarm	
Medical Emergency										Medical Emergency/Epidemic	
C. Technological Hazards											
Hazardous Material Spills/Releases										Spills/Releases	
Airplane Crash										Infrastructure Failure	
Energy Emergency										Energy Emergency	
Urban Fire										Urban Fire	
Explosion										Toxic Gas/Acid Rain	
D. Human Imposed Causes											
Terrorism										Riots/On-Site/Off-Site Disturbance	
On-Site/Off-Site Disturbance										Sabotage	
Sabotage										Strikes/Fuel Shortage	
Strikes/Fuel Shortage										Building Shut-Down	

⁵ Adapted from the Secondary Hazard Matrix in the 1999 *Washington State Recovery Plan Coordinating Draft*, Washington State Military Department Emergency Management Division,

APPENDIX I – Policies and Procedures

Recovery Manager

The Emergency Manager will likely be focused on response and immediate concerns of safety following an incident and may have neither staff nor time available to oversee the long-term recovery process. Additional hazards events or emergency situations may arise during the recovery period that will require their full attention. For these reasons it is recommended that if long-term recovery management is required, a Recovery Manager position should be created and a candidate appointed by the Mayor or his Office.

The Recovery Manager could be promoted from within or hired externally. It is possible that current staff may already be overwhelmed and thus an external hire may be the only option. A Recovery Manager should have a background in emergency management, disaster response, or a related field. In addition, the Manager will be working with representatives from several departments as well as the public during the re-visioning process. He/she will be working closely with the Mayor's Office and may at times be the figurehead for the entire recovery process.

Consistent management over the recovery period is important to avoid project stalls and mismanagement. The candidate should be willing and available to manage the process for several years.

The decision to hire a Recovery Manager is at the Mayor's discretion; however, the Mayor should strongly consider the advice of the MIC if that committee believes that a Manager is needed. Attention should also be paid to a recommendation from the MIC if they have a specific candidate; if several candidates are found they should be consulted prior to selection for advice or a recommendation for selection.

Information Collection and Dispersal

Since regular communication lines may be damaged by the hazard and regular services may be interrupted, it is critical that the City is able to gather and distribute information in an accurate and efficient manner. The City shall designate a Chief Information Officer (CIO) and establish an Information Center to accomplish this goal.

Chief Information Officer (CIO) - The appropriate appointee will have extensive background in public communication and media interaction.

Responsibilities Include:

- Act as primary voice for the City regarding the recovery process
- Verify and approve information prior to public distribution
- Manage or hire a manager to run the Information Center
- Attend Recovery Task Force meetings and coordinate with affected agency representatives in order to create consistent and correct information dispersal

Information Center will be the primary location for data collection and dispersal. The Info Center will ensure that data is accumulated, verified, and redistributed in a concise, clear and efficient manner.

- Gather public comments about conditions or additional hazards and distribute that information to the relevant agencies
- Maintain and update public information outlets, including, but not limited to:
 - o General telephone hotlines
 - o Radio broadcasts
 - o Mailers
 - o Web sites
 - o Emergency text message notifications
 - o Public bulletin boards
 - o Press releases
 - o Public notices
 - o Comment forms
- Maintain and update contact information for:
 - o Relevant agencies in all levels of government
 - o Social services, aid workers, and volunteer organizations
 - o Approved private contractors
 - o Translators or translation services, including those for the hearing impaired
- **Determine** what information is ready for public release and when, under supervision of the CIO.
- Utilize all available forms of communication to maximize the spread of information.
- Maintain a database of pre-translated phrases to be used in case of emergency, some of which should be printed on signs and copies kept available in EOCs

Public Process

Participation in the planning process after a disaster is essential to empower the public, retain investment in the community and avoid future conflicts. Networks and contacts can also be made during the process that enhance the resiliency and support structure of individuals. The level of planning and public process necessary will vary depending on the extent of the damage. Public participation may be more appropriate on a neighborhood level for a minor event, while citywide planning would be applicable to a catastrophic event.

The public should be involved in all stages of the planning/revisioning process. However, the public should be aware of budget, time, or physical constraints on the project. Once initial ideas have been brainstormed, the City should review the ideas and ask for public feedback regarding the plausible options.

- For instance, transportation engineers should select a variety of possible sites that would fit within the larger network and have the right physical qualities before presenting them to the public, and then let the public decide on the

- preference of sites.
- If for some reason the public's preferred solutions are later found to be impossible to act upon, this decision should be explained clearly and communicated publicly, especially to the participants who voted.

In the chaotic time following a hazard event, marginalized groups may face additional stresses that prohibit public process participation. In order to achieve maximum recovery, the City shall seek broad public input. The City should accommodate the needs of the citizens while organizing meetings and gathering public feedback. Limitations of certain community groups should be recognized and accommodated. Meetings should be held at various locations and times. Consider collecting information about public opinion at natural gathering places, such as assistance lines. Publish bus routes and offer alternative methods for participation that do not require in person participation.

Public participation includes both collecting and dispersing information to the citizens. Collect contact information from participants and offer a website and/or physical location for citizens to keep updated on the progress of the plan and the final decisions that were made. A contact number for questions about the process may also be instituted and assigned to a single staff member who can collect information.

Support Structure

The Responsibility Matrix (above) explains which agency should take lead on an issue, or where to get further support or information within the City. If there are unmet needs or a need for change, the MIC will allocate new responsibilities. An alternative structure for communication should be created prior to an event. Since regular avenues of communication may be limited due to exacerbated responsibilities or physical communication barriers, employees should have information about where to direct requests. A contact list should be distributed to all agencies indicating where to direct requests for information or support. The contact list must be updated annually, during emergency management drills. The list should be maintained by the MIC or the Information Center.

Training, exercises, drills

Training, exercises, and drills regarding recovery should be part of the regular Emergency Management drills. This will ensure that staff will be able to perform emergency duties and train other staff or volunteers to take the roles in the aftermath of an event. The MIC should cover the following topics during the training:

- Scenario based drills
- Information dispersal
- Damage assessment
- Building or infrastructure inspection
- Federal form filing
- First response

Classes should be offered to City employees, contractors and volunteers. Drills should be conducted on an annual basis. Through these drills, sources of unidentified capabilities and vulnerabilities should be identified and addressed.

Redundancy and preparedness

In the case of a major hazards event, certain portions of the City may not be able to function at an adequate level. An earthquake or flood may isolate the hill neighborhoods from the valley neighborhoods. Shaking during an earthquake may leave the downtown area, the current location for response and recovery management, dangerous. Response and recovery supplies should be available in multiple locations to ensure that supplies can be delivered.

Response and recovery supplies, such as radios, spare batteries, signage, forms, contact information, and any other items identified by first responders, this plan, or a MIC team member, should be kept in at least two, preferably three or more backup locations.

- Storage locations should coincide with the location of Emergency Operations Centers or other First Response areas, but if sufficient space is not available, a nearby storage space could be leased from a private entity.
- Given the hazards assessment in the HMP, backup supply areas should be not all be located in areas susceptible to the same hazard, or in areas that may be at risk from secondary hazards (see Secondary Hazards Matrix, above).
- Several copies of any forms, signs, manuals, or other papers should be on hand in case of power outage or damage to copiers or computers.
- Other avenues of communicating to the public - radio broadcast equipment, flip charts, or bulletin boards with plastic covers, should also be stored here in case of a catastrophic event or communication network breakdown.

APPENDIX II – Minor Disaster (HMP Scenario 3)**Scenario 3: Landslide affecting homes**

At 10 p.m. on November 5th, after several weeks of rain, a section of hillside in the Education Hill area gave way. Three homes slid fifty feet down the hillside, depositing debris in the backyards of several other homes, which were not damaged directly but lost landscaping and auxiliary structures (e.g. storage sheds). The residents and the City are cleaning up the large amounts of debris. Five people were injured, but there were no life-threatening injuries. Although neighboring homes are currently stable, monitoring will continue as the section that gave way continues to occasionally crumble. The road above the hill has been closed due to instability. The debris blocked a culvert at the bottom of the hill and caused two feet of flooding on sections of SR-202, Redmond-Woodinville Road. The road was closed for thirty-six hours before crews were able to restore normal traffic flow.

Recovery Activities for this scenario

- The lead agency (likely Emergency Management) will assign responders to verify the safety of the area and nearby homes.
- Localized evacuation of nearby homes will be immediate and hotel vouchers can be offered to affected families.
- Police will assist in securing the area and managing temporary traffic changes. The Chief Information Officer will provide police with pre-printed safety signage that includes multiple language translation.
- Debris removal contractors will be activated as per their pre-assigned contracts to help clear the debris from the culvert.
- Planners and emergency management staff, along with input from building inspectors, construction engineers, geologists, ecologists, and any other available and applicable experts, will develop a temporary building moratorium for the area to allow for studies of the safety of the hillside.
- Individual financial assistance, referrals, and counseling options will be offered to the affected families by the Planning and Community Development, with support from Finance and Information Services.
- A localized transportation recovery plan to determine the future of the destroyed portion of road will be drafted, heavily referencing the Neighborhood Plan and Comprehensive Plan. There may be a small community meeting for neighbors in the immediate area to ensure that solutions will not create or exacerbate problems, and discover existing issues that could be solved during the process.
- Federal or state mitigation and recovery fund programs should be utilized to minimize costs to the city.

Threshold for additional considerations

- If other long-standing issues pre-existed the landslide, such as traffic gridlock, lack of open space, or other concerns, a recovery planning process for the immediate area may be in order. A program to buy out homes in danger of sliding and secure the hillside could be federally funded, and the purchased land then used for a hillside park.

APPENDIX III – Major Disaster (HMP Scenario 2)

Scenario 2: Winter storm with power outages

Snow began falling heavily at 1 a.m. on January 7th and continued in periodic showers for 8 days, depositing a total of 2 feet of precipitation. When the snow stopped on January 15th, the accumulation on uncleared roads averaged 10 inches, with drifts up to 3 feet. Sidewalks were invisible under the snow and there were several instances of pedestrian and vehicular paths crossing, resulting in 36 minor accidents and 5 major accidents with 3 traffic-related fatalities. The city's power grid had several temporary shutdowns and repairs, but was consistently off from midnight on January 13th to 3 p.m. on January 15th.

High volumes of snowfall caused ceiling leakage and some buckling on 36 commercial and office buildings with flat roofs, causing approximately \$1 million in damaged equipment and repair costs. Storm drains overflowed in several areas from debris, snowpack, and frozen water, and an ice jam on the Sammamish River flooded parts of West Lake Sammamish Parkway NE at the 520 off ramps, causing major traffic delays for 8 hours on the 14th. Many citizens were unable to drive and large numbers of businesses were closed for several days. Roads that were cleared were congested with triple the usual numbers of traffic due to impassible roads elsewhere. A family of four died of carbon monoxide poisoning after bringing a generator into their home, and 10 house fires from candles and woodstoves caused above the usual amount of damage, due to delayed response times caused by poor road conditions. Businesses in the food industry, particularly grocery stores, discarded over 6 tons of rotting perishables. The loss of electricity compromised the most common of communication systems, making standard lines of communication unavailable, including RCTV and the internet. Several businesses sought additional loans to cover company-wide vacation time and loss of revenue and inventory; three small businesses declared bankruptcy.

Recovery Activities for this Scenario

- Emergency Management activated backup plows
 - o Prior to the event, a network of individuals and private contractors with the ability to plow roads was alerted that they may be activated in the next few days. Each had pre-existing signed contracts with the city to be reimbursed following the event, a call-in number to offer availability, and a landline to be contacted. Maps with assigned areas had already been distributed. Some individuals were reimbursed with the cost of the plow, or signed up for a program where part or all of the cost was deducted out of their plow pay.
 - o These individuals were contacted based on location, availability and areas in need of plowing and were activated and assigned an area to plow.
 - o After each round of plowing, the contractor reported in that the area had been cleared. This information was updated on all communication platforms (news reports, web, phone, radio).
 - The individuals then had forms that documented the number of times they plowed the area and the time spent.

- FIS collected the contractor/individual time forms and added those totals into the total disaster costs. Contractors were paid within 3 weeks from emergency funds. Additional funding was provided by the State OEM and the city was reimbursed.
- Warming shelter locations and open businesses with backup generators were advertised through community groups, TV, radio announcements, the city's information hotline and the emergency radio channel. Warnings about carbon monoxide poisoning and fire safety information were included in several languages.
- Short-term, zero interest loans were offered to businesses to cover employee vacation pay, loss of business and loss of supplies. Individual assistance loans to repair damage was also offered to any homes with leakage or those affected by backup flooding. Most loans were repaid within 6 months with insurance checks.
- Businesses that had entered into the Redmond Business Partnership Initiative (recommended in the HMP, Action Item 5-2) were able to share storage, reducing the amount of rotted food. Some side-by-side businesses were able to stay open by sharing generator power or condensing their operations into a single storefront.

Threshold for additional considerations

Lessons from the disaster were utilized in the next round of community and comprehensive planning, including areas where gridlock occurred and where icing isolated groups of homes. Alternate traffic routes and additional walking trail locations were identified during the public process.

APPENDIX IV – Catastrophic Event (HMP Scenario 1)**Scenario: Earthquake**

At 1:38pm on March 18th a 6.7 magnitude earthquake occurs along the Seattle fault. The epicenter is located within two miles directly south of Redmond. The massive shaking caused over \$980 million of damage and 57 casualties. The magnitude of the earthquake was similar to the 2001 Nisqually earthquake, but the violent ground shaking caused much more damage. The earthquake caused damage to 5,547 of the City's 17,000 buildings.

Transportation systems within the City of Redmond also sustained damage. Two bridges were damaged, but one regained functionality after the day of the event. The total cost of damage to the transportation system was over \$30.2 million. Regional transportation failures, such as the collapse of the SR 520 bridge, limited Redmond's access to regional facilities that were already overwhelmed.

Lifeline utilities were also damaged. On the day of the earthquake, 231 leaks and 58 breaks in the water lines left over 8000 households without access to potable water. Service was promptly restored within 72 hours. 11,501 households lost electricity. In addition to the immediate damage of the earthquake, fires broke out across the City and caused an additional \$13 million of damages.

The biggest problem has been the lack of a local medical facility and the fact that the regional hospitals were overwhelmed.

Recovery Activities for this Scenario

- Working with State and Federal agencies
 - o In a Catastrophic Scenario, large portions of Washington State will likely be affected, and resources will be concentrated towards the larger population centers, if they are affected.
 - o Federal Assistance in terms of National Guard deployment, FEMA employees, and other personnel will likely be assigned to the area.
 - o Identifying the key contacts in each department for visiting personnel, meeting locations, resources needed and scheduling meetings will begin early in the process; Information Center staff should take point in managing these needs.
- Handling media, volunteers, donations and visitors
 - o The CIO should immediately notify all department heads of information restrictions and to redirect all media inquiries to the CIO office or Information Center. Department heads shall pass this information on to all of their staff, along with contact information for the CIO/Information Center.
 - o The CIO/Information Center shall immediately identify an area to serve as a media center, including areas for reporters to gather, rest, get credentials/ID and receive updates.
 - o The Information Center should prepare to activate its volunteer center,

identify the required paperwork, and assign staff to intake, assign, and train volunteers as needed.

- If the Information Center is understaffed or otherwise overwhelmed, they should begin by training assistance staff.
- If volunteers are minimal or delayed, Information Center staff should notify other department heads or MIC members of their availability until needed, or default back to their home departments.
- o The FIS should create a non-profit emergency donations account and appropriate paperwork prior to an event so that donations can be immediately routed and accepted correctly for tax-exempt status, tracking, and oversight purposes.
 - The Information Center should have this information on-hand to distribute.

Public Process

- For a Catastrophic Event, the public process component is necessary to provide an opportunity for all stakeholders to contribute to the recovery planning. The damage will be widespread; consequently, a comprehensive revisioning process will be critical to realize effective solutions. Additionally, revisioning can assist to reunite a community that is stressed by a disaster.
- Revisioning is similar to comprehensive planning in that it will be addressing interrelated concerns that impact large portions of the City infrastructure and character. However, the urgency of recovery requires that the process be compressed. For instance, Greensburg, KS completed its revisioning process and published a plan approximately 13 weeks after a tornado damaged or destroyed 90% of the city.
- Public participation shall be encouraged throughout the entire revisioning process. Input shall be gathered immediately after the earthquake and public comment/approval shall be sought through all stages of the process.
- Due to the personal hardships of the event, marginalized populations have the potential to become even less involved in the revisioning process than during a typical planning process. However, the most vulnerable and marginalized populations are crucial to planning a future where Redmond is more resilient to hazards. In order to obtain input from the public, the City shall use non-traditional means to gather data. The City should go to the people gather input. If large populations are congregating at distribution centers, the City should organize information collection through meetings, charettes or personal interviews with citizens. Consider alternative locations, times, formats, and languages for gathering public opinion.
- Consideration should be made of regional affects of the event when making decisions, such as the collapse of the Evergreen Point Floating Bridge or devastation of nearby cities. For some projects, collaboration with county, State or regional agencies early in the process will save large amounts of time and money and streamline the process. Redmond shall provide space for the public to provide feedback for changes to the regional systems.

Financial Options

- In addition to federal, State, county, city, or volunteer funds, all possible income sources should be considered to ensure that the goals of the Comprehensive or Revisioning plan are adequately realized.
- Community Development Block Grants, Small Business Administration, and Economic Development Administration funds can be applied toward rebuilding communities' economies after disasters.⁶
- Other common planning tools that can be repurposed for long-term recovery include:
 - o special taxing or assessment districts
 - o Tax Increment Financing (TIF)⁷
 - o impact fees
 - o differential taxation
 - o urban renewal or redevelopment funds
 - o public mortgage lending subsidies
 - o transfer of development rights
- PCD and FIS staff should work together to review the available options for funds before beginning the public process, so that questions about timelines, limitations, and additional costs to citizens can be more definitively answered.

Recovery Phases

- Short Term Recovery
 - o Short term recovery begins immediately after an event begins, at the same time as response.
 - o The first priority is to minimize secondary hazards. This includes inspecting damaged infrastructure to determine if it is able to continue functioning safely, and informing all possible users in a timely and effective manner.
 - If a structure is too damaged to function, or an area is declared unsafe, the lead department must identify as quickly as possible what effect the loss of its use will have on residents.
 - o It may be possible to restore the lost function with a different, alternative solution, rather than rebuilding what existed previously and failed during the event.
 - o These decisions must take into account that temporary solutions often last longer than intended or can become permanent; this can include traffic rerouting or housing.
 - In the long run, it may be more beneficial to delay repair or reconstruction if there is a possibility that extra time dedicated to a planning or design phase can solve problems that existed before the event.
 - o All efforts should be made to mitigate future disasters during reconstruction, in accordance with the Hazard Mitigation Plan.
 - o Decisions to rebuild or repair should always be considered in light of the visions and goals of the Comprehensive Plan.

⁶ *Planning for Post-Disaster Recovery and Reconstruction*, American Planning Association, 1998, p. 137.

⁷ Note that Washington has several financial restrictions and TIF may not be as successful as other states.

- o Federal or state assistance funds provided for post-disaster reconstruction can offset future costs to residents and assist economic recovery and should be fully utilized whenever possible.
 - Tracking expenses correctly is a basic requirement for funds and assistance and should be given heavy weight.
- Long Term Recovery
 - o Once immediate functions have been restored and health and safety are assured, long term recovery begins.
 - o If several structures or large areas are affected, a separate Recovery Plan will likely be required to coordinate efforts and ensure the efficient use of resources.
 - Recovery Plans must always include input from members of the public, particularly those most affected by recovery (e.g. closest to the area, users of the structures, business owners).
 - Different types of public participation and input are covered in more detail in the Appendices, dependent upon the scale or type of disaster.
 - o The Recovery Plan, dispersal of repair or reconstruction funds, granting of permits and any other recovery decisions must always be considered in light of the vision and goals outlined in the most recent Redmond Comprehensive Plan.
 - Whenever possible, repair plans should be aimed not at just returning to status quo, but upgrading to the future needs or requirements of the city (e.g. instead of replacing a broken water pipe with the same type, Public Works may place larger pipes to account for expected growth or annexation).
 - Temporary housing facilities should be located close to future growth areas whenever possible, so that local businesses may recovery more quickly by providing services to those located there. Those temporarily housed in one area may choose to stay in that area and should have that option.
 - o Pre-approved ordinances (e.g. zoning to allow temporary housing in appropriate areas, ability to enact curfews in the event of a disaster, emergency contracting) written and passed before an event will significantly save time and money when an event occurs. Examples of ordinances and other planning tools are available in *Planning for Post-Disaster Recovery and Reconstruction*, APA 1998, Chapter 5.

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Further Information

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Public Participation and Improving Quality of Life During Recovery

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Glossary

CEMP: Comprehensive Emergency Management Plan.

CIO: Chief Information Officer, City of Redmond (recommended new position).

FEMA: Federal Emergency Management Agency.

FIS: Finance and Information Services, a department in the City of Redmond.

HMP: Redmond Hazards Mitigation Plan, 2009 Update.

MIC: Mitigation Implementation Committee. A group of representatives from several departments in Redmond that guided the 2009 Hazard Mitigation Plan Update.

PCD: Planning and Community Development, a department in the City of Redmond.

TIF: Tax Increment Financing. Legalized in Washington in 2001, it is intended to raise funds for redevelopment by increasing property values in the redevelopment area if and when their value rises, as it is expected to do following investment. Note that Washington has several financial restrictions and TIF may not be as successful as other states.

Published by
University of Washington
College of Built Environments
Department of Urban Design and Planning
in conjunction with
City of Redmond

September 10, 2009

